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TRANSACTIONS

OF THE

AMERICAN

SURGICAL ASSOCIATION.

VOLUME THE TWENTY-FIRST.

EDITED BY

RICHARD H. HARTE, M.D.,
RECORDER OF THE ASSOCIATION.

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(Report by Title.)

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WM. L. RODMAN, M.D.

Place of next meeting:

ST. LOUIS, MISSOURI, 1904.

Time not arranged.

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FRANK J. LUTZ, M.D.

LIST OF THE PRESIDENTS

OF THE

ASSOCIATION FROM THE TIME OF ITS INSTITUTION.

ELECTED

1880. †SAMUEL DAVID GROSS, M.D., LL.D., D.C.L. Oxon., LL.D. Cantab., LL.D. Edin.—Founder of the Association.
1883. †EDWARD MOTT MOORE, M.D., LL.D.
1884. †WILLIAM THOMPSON BRIGGS, M.D.
1885. †MOSES GUNN, A.M., M.D., LL.D.
1886. †HUNTER McGUIRE, M.D., LL.D.
1887. †D. HAYES AGNEW, M.D., LL.D.
1888. DAVID WILLIAMS CHEEVER, M.D., LL.D.
1889. †DAVID W. YANDELL, M.D.
1890. †CLAUDIUS HENRY MASTIN, M.D., LL.D.
1891. PHINEAS SANBORN CONNER, M.D., LL.D.
1892. NICHOLAS SENN, M.D., Ph.D., LL.D.
1893. J. EWING MEARS, A.M., M.D.
1894. FREDERIC SHEPARD DENNIS, M.D.
1895. LOUIS McLANE TIFFANY, A.M. Cantab., M.D.
1896. JOHN COLLINS WARREN, M.D., LL.D. (Jefferson), Hon. F.R.C.S. Eng.
1897. THEODORE F. PREWITT, M.D.
1898. WILLIAM W. KEEN, A.M., M.D., LL.D., Hon. F.R.C.S. Eng.
1899. ROBERT F. WEIR, A.M,, M.D., F.R.C.S. Eng.
1900. ROSWELL PARK, M.D.
1901. DE FOREST WILLARD, A.M., M.D., Ph.D.
1902. MAURICE H. RICHARDSON, A.B., M.D.
1903. NATHANIEL P. DANDRIDGE, M.D.

† Deceased.

NOTICE.

This volume of Transactions contains the papers read before the Association at the Meeting held May 12–14, 1903.

The Association assumes no responsibility for the statements and opinions published in this volume.

FELLOWS

OF THE

AMERICAN SURGICAL ASSOCIATION.

MAY, 1903.

* Denotes Original Fellows.

ELECTED

1890. ABBE, ROBERT, M.D., 13 West Fiftieth Street, New York. Surgeon to St. Luke's Hospital. *Vice-President*, 1901.

1894. ALLEN, DUDLEY P., A.M., M.D., *Secretary*, 278 Prospect Street, Cleveland, Ohio. Professor of Surgery, Medical Department of Western Reserve University; Visiting Surgeon, Lakeside and Charity Hospitals; Consulting Surgeon to the Cleveland City Hospital.

1890. ALLIS, OSCAR HUNTINGTON, A.M., M.D., 1604 Spruce Street, Philadelphia. Surgeon to the Presbyterian Hospital.

1902. ANDREWS, E. W., M.D., 2525 Prairie Avenue, Chicago, Ill.

1901. ARMSTRONG, GEORGE E., C.M., M.D., 320 Mountain Street, Montreal. Associate Professor of Clinical Surgery, McGill University; Surgeon to the Montreal General Hospital; Surgeon to the Western Hospital, Montreal.

1882. BARTON, JAMES M., A.M., M.D., 1337 Spruce Street, Philadelphia. Surgeon to the Jefferson Medical College Hospital and to the Philadelphia Hospital.

1896. BAXTER, GEORGE A., A.M., M.D., Chattanooga, Tennessee. Professor of Surgery, Chattanooga Medical College.

1901. BELL, JAMES, M.D., 873 Dorchester Street, Montreal. Professor of Clinical Surgery, McGill University; Surgeon to the Royal Victoria Hospital.

ELECTED

1900. BEVAN, ARTHUR DEAN, M.D., 100 State Street, Chicago. Associate Professor of Surgery, Rush Medical College, University of Chicago; Surgeon to Presbyterian Hospital.

1901. BINNIE, J. F., M.B., C.M. (Aberdeen), Twelfth and Wyandotte Streets, Kansas City, Mo. Professor of Surgical Pathology and Clinical Surgery, Kansas City Medical College.

1902. BLAKE, Joseph A., M.D., 601 Madison Avenue, New York. Instructor in Surgery, Columbia University; Attending Surgeon to St. Luke's Hospital; Junior Surgeon to the Roosevelt Hospital; Consulting Surgeon to the Northern Dispensary.

1901. BLOODGOOD, JOSEPH C., B.S., M.D., 923 North Charles Street, Baltimore, Md. Associate in Surgery in the Johns Hopkins University.

1882. BONTECOU, REED BROCKWAY, M.D., 82 Fourth Street, Troy, N. Y. Surgeon to the Marshall Infirmary.

1901. BOSHER, LEWIS C., M.D., 717 Franklin Street, Richmond, Va. Professor of Surgery, Medical College of Virginia; Surgeon to the Old Dominion Hospital.

1890. BRADFORD, EDWARD HICKLING, A.B., M.D., 133 Newbury Street, Boston. Surgeon to the Children's and the Samaritan Hospitals; Assistant Professor of Orthopedic Surgery in the Harvard University.

1900. BREWER, GEORGE EMERSON, M.D., 68 West Forty-sixth Street, New York City. Junior Surgeon, Roosevelt Hospital; Attending Surgeon, City Hospital; Assistant Demonstrator of Anatomy in College of Physicians and Surgeons (Columbia University), New York.

*1880. BRINTON, JOHN H., M.D., 1423 Spruce Street, Philadelphia. Professor of the Practice of Surgery and of Clinical Surgery in the Jefferson Medical College; Surgeon to St. Joseph's Hospital. *Treasurer*, 1884–85.

1895. BRYANT, JOSEPH D., M.D., 32 West Forty-eighth Street, New York. Professor of Anatomy and of Operative and Clinical Surgery, Bellevue Hospital Medical College; Surgeon to Bellevue and St. Vincent's Hospitals; Consulting Surgeon to Gouverneur Hospital, Hospital for Ruptured and Crippled, St. Joseph's and Hackensack Hospitals, Asylum for Insane, New York, etc.

1882. BULL, WILLIAM TILLINGHAST, A.B., M.D., 35 West Thirty-fifth Street, New York. Adjunct Professor of the Practice of Surgery and of Clinical Surgery in the College of Physicians and Surgeons, New York; Surgeon to the New York and

ELECTED

St. Luke's Hospitals; Consulting Surgeon to the Hospital for Ruptured and Crippled, and to the New York Cancer Hospital.

1900. BUNTS, FRANK E., M.D., 275 Prospect Street, Cleveland, Ohio. Professor of Principles of Surgery and Clinical Surgery in Medical College of Western Reserve University; Visiting Surgeon to St. Vincent's Charity Hospital; Consulting Surgeon to Cleveland City and Lutheran Hospitals.

1893. BURRELL, HERBERT LESLIE, M.D. (Harvard), 22 Newbury Street, Boston, Mass. Assistant Professor of Surgery in Harvard University; Visiting Surgeon, Boston City Hospital; Visiting Surgeon, The Children's Hospital; Consulting Surgeon, Carney Hospital and the Quincy Hospital. *Secretary*, 1895–1901.

1889. CABOT, ARTHUR TRACY, A.M., M.D., 3 Marlborough Street, Boston, Mass. Surgeon to Massachusetts General Hospital.

1885. CARMALT, WILLIAM H., A.M., M.D., 87 Elm Street, New Haven, Conn. Professor of Surgery in Yale University; Surgeon to the New Haven Hospital. *Vice-President*, 1895.

1896. CARSON, NORMAN BRUCE, M.D., 3505 Olive Street, St. Louis, Mo. Professor of Clinical Surgery in the St. Louis Medical College; Surgeon to the St. Louis and Mullanphy Hospitals and to the St. Vincent Insane Asylum, etc. *Vice-President*, 1903.

1882. CHEEVER, DAVID WILLIAMS, M.D., LL.D., 557 Boylston Street, Boston, Mass. Professor of Surgery (Emeritus) in Harvard University; Surgeon to the Boston City Hospital. *President*, 1888.

1896. COLE, CHARLES KNOX, A.M., M.D., Helena, Montana. Surgeon to St. John's, St. Peter's, and County Hospitals.

1898. COLEY, WILLIAM B., M.D., 5 Park Avenue, New York. Attending Surgeon to the General Memorial Hospital; Associate Surgeon to the Hospital for Ruptured and Crippled, New York.

*1880. CONNER, PHINEAS SANBORN, M.D., LL.D., 215 West Ninth Street, Cincinnati, Ohio. Professor of Surgery in the Medical College of Ohio; Emeritus Professor of Surgery, Dartmouth Medical College; Surgeon to the Cincinnati and the Good Samaritan Hospitals. *President*, 1891; *Member of Council*, 1883 and 1895–1900; *Treasurer*, 1885–91.

1896. CURTIS, BENJAMIN FARQUHAR, A.B., M.D., 7 East Forty-first Street, New York. Professor of the Principles of Surgery and

ELECTED

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1896. Cushing, Hayward Warren, A.B., M.D., 70 Commonwealth Avenue, Boston, Mass. Junior Visiting Surgeon, Boston City Hospital; Assistant Surgeon, Children's Hospital, Boston.

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1883. Dandridge, Nathaniel Pendleton, M.D., *President*, 422 Broadway, Cincinnati, Ohio. Professor of Practice of Surgery and of Clinical Surgery in the Miami Medical College, Cincinnati. *Treasurer*, 1894–96.

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1899. Dunn, James H., M.D., 337 Oak Grove Street, Minneapolis, Minn. Professor of Practice of Surgery, Medical Department, University of Minnesota.

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1882. Gay, George Washington, A.M., M.D., 665 Boylston Street, Boston, Mass. Senior Surgeon to the Boston City Hospital; Clinical Instructor in Surgery in Harvard University. *Member of Council*, 1882.

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1901. HUNTINGTON, THOMAS W., A.B., M.D., 1118 Sutter Street, San Francisco, California. Professor of Clinical and Operative Surgery, Medical Department, University of California; Visiting Surgeon to the City and County Hospital, San Francisco; Consulting Surgeon, St. Luke's Hospital, San Francisco.

1901. JACOBSON, NATHAN, M.D., 430 South Salina Street, Syracuse, N. Y. Professor of Clinical Surgery, College of Medicine, Syracuse University; Surgeon to St. Joseph's Hospital.

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1896. JOHNSTON, GEORGE BEN, M.D., 207 East Grace Street, Richmond, Va. Professor of the Practice of Surgery and of Clinical Surgery in the Medical College of Virginia; Surgeon to the Old Dominion Hospital, and Consulting Surgeon to the Richmond City Free Dispensary.

1901. JONAS, A. F., M.D., 106 South Thirty-first Avenue, Omaha, Nebraska. Professor of Surgery, Omaha Medical College; Surgeon to the Methodist Episcopal Hospital and to the Douglas County Hospital.

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*1880. KEEN, WILLIAM WILLIAMS, A.M., M.D., LL.D., Hon. F.R.C.S., Eng., 1729 Chestnut Street, Philadelphia. Professor of the Principles of Surgery and of Clinical Surgery in the Jefferson Medical College; Surgeon to the Jefferson Medical College Hospital and to the Orthopædic Hospital and Infirmary for Nervous Diseases; Consulting Surgeon to the Woman's and St. Agnes' Hospitals; Membre Correspondant Etrangé de la Société de Chirurgie de Paris; Membre Honoraire de la Société Belge de Chirurgie. *President*, 1898; *Vice-President*, 1892; *Member of Council*, 1899–1901.

1901. LA GARDE, LOUIS A., M.D., United States Soldiers' Home, Washington, D. C. Professor of Military Surgery, New York University and Bellevue Hospital Medical College; Major and Surgeon United States Army.

1889. LANGE, FREDERICK E., M.D., 691 Lexington Avenue, New York.

1901. LE CONTE, ROBERT G., A.B., M.D., 1530 Locust Street, Philadelphia. Associate Professor of Surgery, University of Pennsylvania; Surgeon to the Pennsylvania, the Children's, and the Bryn Mawr Hospitals.

1903. LUTZ, F. J., M.D., 3337 Lafayette Avenue, St. Louis, Mo.

1901. MCARTHUR, L. L., M.D., 4415 Drexel Building, Chicago, Ill. Professor of Clinical Surgery, Post-Graduate Medical School; Assistant Professor of Clinical Surgery, Rush Medical College; Surgeon to St. Luke's and Michael Reese Hospitals.

1896. MCCOSH, ANDREW J., B.A., M.D., 16 East Fifty-fourth Street, New York. Surgeon to the Presbyterian Hospital; Clinical Lecturer on Surgery, College of Physicians and Surgeons.

1882. MCGRAW, THEODORE A., M.D., 73 Case Street, Detroit, Michigan. Professor of Surgery in the Detroit Medical College; Surgeon to St. Mary's and the Harper Hospitals. *Vice-President*, 1896.

1903. MCMURTRY, LEWIS S., M.D., 1912 Sixth Street, Louisville, Ky.

1901. MACDONALD, WILLIS G., M.D., 27 Eagle Street, Albany, New York.

1899. MARKOE, FRANCIS H., M.D., 15 East Forty-ninth Street, New York. Professor of Clinical Surgery, Medical Department,

ELECTED

Columbia University, New York City; Attending Surgeon, St. Luke's and New York Hospitals; Consulting Surgeon, Orthopædic Hospital.

*1880. MARKS, SOLON, M.D., 136 Wisconsin Street, Milwaukee, Wis. Surgeon to St. Mary's Hospital. *Vice-President*, 1898.

1898. MARTIN, EDWARD, M.D., 1506 Locust Street, Philadelphia. Clinical Professor of Surgery, University of Pennsylvania; Clinical Professor of Surgery, Woman's Medical College, Philadelphia; Surgeon to Philadelphia, St. Agnes', and Howard Hospitals.

1887. MASTIN, WILLIAM MCDOWELL, M.D., Northeast corner of Joachim and Conti Streets, Mobile, Ala. Surgeon to the Mobile City Hospital.

1895. MATAS, RUDOLPH, M.D., 2255 St. Charles Avenue, New Orleans, La. Professor of Surgery, Medical Department, Tulane University; Professor of Clinical Surgery, New Orleans Polyclinic; Surgeon to Charity Hospital; Consulting Surgeon to the Eye, Ear, Nose, and Throat Hospital. *Vice-President*, 1901.

1903. MAYO, CHARLES H., M.D., Rochester, Minn.

1899. MAYO, WILLIAM J., A.M., M.D., 427 West College Street, Rochester, Minn. Surgeon to St. Mary's Hospital. *Vice-President*, 1903.

*1880. MEARS, J. EWING, A.M., M.D., 210 South Seventh Street, Philadelphia. *President*, 1893; *Recorder*, 1881–93.

1901. MEYER, WILLY, M.D., 700 Madison Avenue, New York. Professor of Surgery in the New York Post-Graduate Medical School and Hospital; Attending Surgeon to the German and New York Skin and Cancer Hospitals; Consulting Surgeon to the New York Infirmary for Women and Children.

1893. MIXTER, SAMUEL JASON, S.B. (Massachusetts Institute of Technology), M.D. (Harvard), 180 Marlborough Street, Boston. Surgeon to Massachusetts General Hospital and to Carney Hospital; Consulting Surgeon to the Massachusetts Charity Eye and Ear Infirmary; Instructor in Surgery in the Harvard University.

1896. MONKS, GEORGE HOWARD, A.B. (Harvard), M.D. (Harvard), M.R.C.S. Eng., 67 Marlborough Street, Boston. Surgeon to Carney Hospital; Assistant Visiting Surgeon, Boston City Hospital; Instructor in Clinical and Assistant in Operative Surgery, Harvard Medical School; Instructor in Surgical Pathology, Harvard Dental School.

ELECTED

1895. Moore, James E., M.D., 802 Dayton Building, Minneapolis, Minn. Professor of Clinical Surgery, University of Minnesota; Surgeon to St. Barnabas' and Northwestern Hospitals; Consulting Surgeon to St. Mary's and City Hospitals.

1898. Morton, Thomas S. K., M.D., 1506 Locust Street, Philadelphia.

1900. Munro, John C., M.D., 173 Beacon Street, Boston. Instructor in Surgery, Harvard; Professor of Surgery, Tufts College Dental School; Assistant Visiting Surgeon, Boston City Hospital.

1902. Murphy, John B., A.M., M.D., 100 State Street, Chicago, Ill. Professor of Surgery, Medical Department of Northwestern University, Chicago Post-Graduate School and Hospital, and Chicago Clinical School; Attending Surgeon to Mercy Hospital, Cook County Hospital, and Wesley Hospital; Consulting Surgeon to Alexian Brothers' Hospital and Hospital for Crippled Children.

1898. Murray, Francis W., M.D., 32 West Thirty-ninth Street, New York City. Professor of Clinical Surgery in Cornell University Medical College; Surgeon to the New York and St. Luke's Hospitals.

1882. Nancrede, Charles Beylard, A.M. (University of Pennsylvania), M.D., LL.D. (Jefferson), 720 South University Avenue, Ann Arbor, Mich. Professor of Surgery in the University of Michigan; Professor of Surgery, Dartmouth Medical College. *Vice-President*, 1889 and 1899.

1903. Neilson, Thomas R., M.D., 122 South Seventeenth Street, Philadelphia, Pa. Surgeon to the Episcopal Hospital and to St. Christopher's Hospital for Children; Clinical Professor of Genito-Urinary Diseases in the University of Pennsylvania.

1900. Ochsner, A. J., B.S., F.R.M.S., M.D. Eng., 710 Sedgwick Street, Chicago. Professor of Clinical Surgery, College of Physicians and Surgeons; Surgeon-in-Chief of Augustana and St. Mary's Hospitals.

1900. Oliver, J. C., M.D., 628 Elm Street, Cincinnati, Ohio. Professor of Descriptive Anatomy, Miami Medical College; Surgeon, Cincinnati, Presbyterian, and Christ Hospitals.

1882. Owens, John E., M.D., 1201 Venetian Building, Chicago, Ill. Professor of Principles and Practice of Surgery and Clinical Surgery in the Chicago Medical College; Surgeon to St. Luke's Hospital. *Vice-President*, 1900.

ELECTED

1899. Parham, Frederick William, M.D., 1429 Seventh Street, New Orleans, La. Professor of General Clinical and Operative Surgery on the Cadaver, New Orleans Polyclinic; Surgeon to Charity Hospital; Consulting Surgeon to Eye, Ear, Nose, and Throat Hospital.

1885. Park, Roswell, A.M., M.D., 510 Delaware Avenue, Buffalo, N. Y. Professor of Surgery in the Medical Department of the University of Buffalo; Surgeon to the Buffalo General Hospital; Consulting Surgeon to the Fitch Accident Hospital. *President*, 1900; *Vice-President*, 1893; *Member of Council*, 1893–94, 1901–03.

1893. Parmenter, John, M.D., 519 Franklin Street, Buffalo, N. Y. Professor of Anatomy and Clinical Surgery in the Medical Department of the University of Buffalo; Surgeon to the Sisters of Charity, Erie County, Fitch, Children's, and Emergency Hospitals; Assistant Surgeon to the Buffalo General Hospital.

1889. Pilcher, Lewis S., A.M., M.D., LL.D. (Dickinson), 145 Gates Avenue, Brooklyn, N. Y. Professor of Clinical Surgery in the Post-Graduate Medical School, New York; Surgeon to the Methodist Episcopal Hospital, New York. *Vice-President*, 1893.

1887. Porter, Charles Burnham, A.M., M.D. (Harvard), 5 Arlington Street, Boston, Mass. Professor of Clinical Surgery in Harvard University; Surgeon to the Massachusetts General Hospital. *Vice-President*, 1892.

1882. Porter, William Gibbs, M.D., 1118 Spruce Street, Philadelphia. Surgeon to the Presbyterian Hospital.

1896. Powers, Charles A., M.D., *Vice-President*, Fourteenth and Stout Streets, Denver, Col. Professor of Surgery in the University of Denver, and Surgeon to the Arapahoe County Hospital and to St. Luke's Hospital.

1882. Prewitt, Theodore F., M.D., 4917 Berlin Avenue, St. Louis, Mo. Professor of the Principles of Surgery in the Medical Department of Washington University; Surgeon to St. John's Hospital. *President*, 1897; *Vice-President*, 1886; *Member of Council*, 1894–96.

1886. Ransohoff, Joseph, M.D., F.R.C.S. Eng., 706 Walnut Street, Cincinnati, Ohio. Professor of Anatomy in the Medical College of Ohio; Surgeon to the Cincinnati and the Good Samaritan Hospitals.

ELECTED

1887. Richardson, Maurice Howe, A.B., M.D., 224 Beacon Street, Boston, Mass. Surgeon to the Massachusetts General Hospital; Assistant Professor of Clinical Surgery in Harvard University. *President*, 1902; *Vice-President*, 1897; *Secretary*, 1894–96; *Member of Council*, 1903.

1901. Rixford, Emmet, B.S., M.D., 1813 Pierce Street, San Francisco, Cal. Professor of Surgery in Cooper Medical College; Surgeon to the City, County, and Lane Hospitals.

1882. Roberts, John B., A.M., M.D., 1627 Walnut Street, Philadelphia. Professor of Anatomy and Surgery in the Philadelphia Polyclinic; Surgeon to the Methodist and Jewish Hospitals. *Vice-President*, 1888 and 1894; *Treasurer*, 1892–93.

1898. Rodman, William L., A.M., M.D., 1626 Spruce Street, Philadelphia. Professor of the Principles of Surgery and Clinical Professor of the Principles and Practice of Surgery and Clinical Surgery in the Woman's Medical College, Philadelphia. Surgery in the Medico-Chirurgical College, Philadelphia;

1882. Rushmore, John Dikeman, M.D., 129 Montague Street, Brooklyn, N. Y. Professor of Surgery in the Long Island College Hospital; Surgeon to the Brooklyn, St. Peter's, and the Eye and Ear Hospitals.

1882. Senn, Nicholas, M.D., Ph.D., LL.D. (Jefferson), 532 Dearborn Avenue, Chicago, Ill. Professor of the Principles of Surgery and Clinical Surgery in Rush Medical College; Surgeon to Presbyterian Hospital; Surgeon-in-Chief to St. Joseph's Hospital. *President*, 1892; *Member of Council*, 1897.

1902. Shepherd, Francis J., M.D., 152 Mansfield Street, Montreal, Canada. Professor of Anatomy and Lecturer on Operative Surgery in McGill University, Montreal; Senior Surgeon to the Montreal General Hospital.

1895. Souchon, Edmond, M.D., 2403 St. Charles Avenue, New Orleans, La. Professor of Anatomy and of Clinical Surgery, Tulane University; Surgeon to Charity Hospital; Consulting Surgeon to the Eye, Ear, Nose, and Throat Hospital. *Vice-President*, 1899.

1900. Taylor, William J., M.D., 1825 Pine Street, Philadelphia. Surgeon to the Orthopædic Hospital and Infirmary for Nervous Diseases, and to St. Agnes' Hospital; Consulting Surgeon to the West Philadelphia Hospital for Women.

ELECTED

1885. Thompson, J. Ford, M.D., 804 Seventeenth Street, N. W., Washington, D. C. Professor of Surgery in the National Medical College; Surgeon to Garfield Memorial and Children's Hospitals.

1882. Thomson, William, M.D., 1426 Walnut Street, Philadelphia. Emeritus Professor of Ophthalmology in the Jefferson Medical College.

1882. Tiffany, Louis McLane, A.M. (Cantab.), M.D., 831 Park Avenue, Baltimore, Md. *President*, 1895; *Member of Council*, 1885–89, and 1896–97.

1882. Vander Veer, Albert, A.M., M.D., Ph.D., 28 Eagle Street, Albany, N. Y. Dean of Albany Medical College; Professor of Didactic Abdominal Surgery and of Clinical Surgery in the Albany Medical College; Consulting Surgeon to St. Peter's Hospital; Attending Surgeon to the Albany Hospital. *Vice-President*, 1898.

1902. Vaughan, George Tully, M.D., 1718 I Street, Washington, D. C. Professor of Principles and Practice of Surgery, Georgetown University; Professor of Surgery and Genito-Urinary Surgery, Washington Post-Graduate Medical School; Chief Surgeon, Georgetown University Hospital; Surgeon, Emergency Hospital; Consulting Surgeon, Government Hospital for the Insane, Washington, D. C.; Assistant Surgeon-General, U. S. Public Health and Marine Hospital Service.

1891. Walker, Edward W., M.D., 96 West Eighth Street, Cincinnati, Ohio. Professor of Surgery, Miami Medical College.

1882. Warren, John Collins, M.D., LL.D. (Jefferson), Hon. F.R.C.S. Eng., 58 Beacon Street, Boston, Mass. Professor of Surgery in Harvard University; Surgeon to the Massachusetts General Hospital. *President*, 1896; *Vice-President*, 1890; *Member of Council*, 1897.

1896. Watson, Francis Sedgwick, A.B., M.D., 92 Marlborough Street, Boston. Surgeon to the Boston City Hospital; Instructor in Genito-Urinary Surgery, Harvard Medical School.

1889. Weeks, Stephen H., M.D., *Vice-President*, 662 Congress Street, Portland, Maine. Professor of Surgery in the Medical School of Maine; Surgeon to Maine General Hospital. *Member of Council*, 1893.

1889. Weir, Robert F., A.M., M.D., Hon. F.R.C.S. Eng., Cor. Mem. Surg. Soc., Paris, 11 East Fifty-fourth Street, New

ELECTED

York. Professor of Surgery in the College of Physicians and Surgeons, Columbia University; Surgeon to the Roosevelt Hospital. *President*, 1899. *Member of Council*, 1893–1896, 1901–03.

1892. WHARTON, HENRY R., A.M., M.D., 1725 Spruce Street, Philadelphia. Surgeon to the Presbyterian, Children's, and Methodist Hospitals.

1882. WHITE, J. WILLIAM, M.D., Ph.D., 1810 South Rittenhouse Square, Philadelphia. John Rhea Barton Professor of Surgery in the University of Pennsylvania.

1882. WILLARD, DE FOREST, A.M., M.D. (Univ. of Pa.), Ph.D., 1818 Chestnut Street, Philadelphia. Professor of Orthopedic Surgery in the University of Pennsylvania; Surgeon to the Presbyterian Hospital; Consulting Surgeon to the Hospital for the Chronic Insane of Pennsylvania, to the New Jersey Training School, to the Germantown and the Atlantic City Hospitals. *President*, 1901; *Recorder*, 1893–1900; *Member of Council*, 1901–03.

1901. WOOLSEY, GEORGE, M.D., 117 East Thirty-sixth Street, New York City. Professor of Anatomy and Clinical Surgery, Cornell University; Surgeon to Bellevue Hospital; Associate Surgeon to the Presbyterian Hospital.

HONORARY FELLOWS.

ELECTED

1885. ANNANDALE, THOMAS, M.R.C.S. Eng., M.D. Edin., 34 Charlotte Square, Edinburgh, Scotland. Regius Professor of Clinical Surgery in the University of Edinburgh.

1894. VON BERGMANN, PROF. DR. ERNST, Geh. Med. Rath., Klin. Institut für Chirurgie, Berlin, Germany.

1891. BRYANT, THOMAS, ESQ., F.R.C.S. Eng., 65 Grosvenor Street, Grosvenor Square, W., London.

1891. CHIENE, JOHN, F.R.C.S. Edin., M.D. Edin., 26 Charlotte Square, Edinburgh, Scotland. Professor of Surgery in the University of Edinburgh.

1885. CZERNY, PROF. DR. VINCENT, 25 Sophien Strasse, Heidelberg, Germany. Professor of Surgery in the University of Heidelberg.

1885. VON ESMARCH, PROF. DR. FRIEDRICH, 2 Hospitalberg, Kiel, Schleswig-Holstein, Germany. Professor of Surgery in the University of Kiel.

1893. GUSSENBAUER, PROF. DR. CARL, ix. Ferstelgasse, Vienna. Imperial and Royal Professor of Surgery and Chief of the Second Surgical Clinic and of the Surgical Institute.

1891. HARRISON, REGINALD, ESQ., F.R.C.S. Eng., 6 Lower Berkeley Street, Portman Square, W., London.

1890. HORSLEY, VICTOR ALEXANDER HADEN, F.R.C.S. Eng., 25 Cavendish Square, W., London.

1883. HORWITZ, P. J., M.D., 1919 Walnut Street, Medical Director U. S. Navy (Retired), Philadelphia.

1894. KOCHER, PROF. DR. THEODOR, Professor of Surgery, University of Berne, 25 Villette, Berne, Switzerland.

ELECTED

1885. Lister, Lord Joseph, F.R.C.S. Eng., D.C.L., LL.D., 12 Park Crescent, London, N. W. Professor of Clinical Surgery in King's College.

1894. Macewen, William, M.D., Mast. Surg., 3 Woodside Crescent, Glasgow, Scotland.

1903. Robson, A. W., M.D., Leeds, England.

1882. Smith, Stephen, A.M., M.D., LL.D., 574 Madison Avenue, New York. Professor of Clinical Surgery in the University Medical College of New York; Surgeon to the Bellevue and the St. Vincent's Hospitals. *Vice-President*, 1890.

1896. Terrier, Dr. Felix, 11 Rue de Solférino, Paris, France. Professor of Operative Surgery in the Faculty of Medicine of Paris; Surgeon to the Hôpital Bichat.

REPORT OF THE COMMITTEE ON NECROLOGY.

JOHN HOMANS, M.D.

Born November 26, 1836. Died February 7, 1903.

JOHN HOMANS was born in Boston November 26, 1836, and died at his home in that city on Saturday, February 7, 1903, in the sixty-sixth year of his age.

His grandfather of the same name was a graduate of Harvard College in 1772, and an army surgeon during the War of Independence; his father, of the same name, was a graduate of Harvard College in 1812, and practised medicine in Boston; his nephew, son of his brother Dr. Charles Homans, a prominent practitioner, whose death occurred in 1902, also bore the same name, as does Dr. Homans' son, at the present time a student of medicine.

Dr. Homans graduated from Harvard College in 1858, and received his degree of M.D. from the Harvard Medical School in 1862. At the outbreak of the Civil War he offered his services to the Government, and was commissioned an Assistant Surgeon in the United States Navy, and served on the gunboat "Aroostook" during the search for the disabled U.S.S. "Vermont" in Hampton Roads, and later on the James River during McClellan's campaign. He was at the battles at Fort Darling, Va., and Malvern Hill. In November, 1862, he was given a commission as Assistant Surgeon in the regular army. He was later at New Orleans and on the staff of General Banks, taking part in the disastrous Red River expedition. Subsequently he was ordered to Washington, and held various surgical appointments in connection with the Army of the Shenandoah. He was Surgeon-in-Chief of the First Division of the Nineteenth Army Corps, was present at the battles of Winchester and Cedar Creek, and ultimately became Medical Inspector on the staff of General Sheridan. He resigned from the army in May, 1865, after an eventful career of a little over three years. After study in Vienna, Paris, and London he returned to Boston, and began to practice his profession in 1866. After serving as Surgeon at the Boston Dispensary, the Children's Hospital, and at the Carney Hospital, and in the Out-patient

Department of the Massachusetts General Hospital, he was appointed Visiting Surgeon to the latter hospital in 1882, and was retired in 1900, having reached the age limit of sixty-three years.

On this occasion the trustees of the hospital expressed their sense of the great value of Dr. Homans' services to the hospital, and in a letter to him they stated further: "Throughout the whole period of his connection with the hospital Dr. Homans' services have been rendered with promptness and fidelity. The intercourse between him and the officers of the hospital has always been of the most agreeable nature. But, besides the faithful performances of his regular duties, Dr. Homans has advanced to its present point the whole treatment of abdominal surgery, and by his skill, courage, and unselfish devotion has added to the reputation of the Massachusetts General Hospital and the welfare of mankind."

At the time of Dr. Homans' entrance into the hospital abdominal surgery was yet in its infancy, but he had already been hard at work as a pioneer in this line of surgery since 1872, when he performed his first ovariotomy. His first five operations, of which only one was a single cyst without adhesions, were done without antiseptic precautions, and all died. In 1877 he began to use carbolic spray, and had his first successful case. The following year he operated on six cases, with only one death. The number of cases rapidly increased. In 1882 forty-five ovariotomies were performed, with six deaths; and in the following year twenty-six, with only one death. In 1888 he operated upon forty cases, without spray, with two deaths. Between 1872 and 1900 Dr. Homans performed 601 ovariotomies. In 1881 he began to perform abdominal hysterectomy, and had, up to 1887, ten deaths, with seventeen recoveries. In 1887 he improved what he considered a faulty technique, and from this year to 1897 he performed 112 abdominal hysterectomies, with fifteen deaths. He was one of the first to open the abdominal cavity in search of an abscess in the region of the appendix.

From this brief sketch of his professional career it will be seen that Dr. Homans lived through an especially interesting period of medical history. His career opened at the close of an era, at a time when all the resources of an ancient and still unimproved system were taxed to their utmost by the outbreak of war.

He was thus thrown at an early age into positions of high responsibility, and acquired an experience of military surgery and a training, not only in the skilful use of the knife, but in dealing with great emergencies, which was of invaluable service to him later in life, and doubtless exercised an important influence in moulding into shape those natural gifts which he possessed in an eminent degree, and which entered so largely into his character as a matured surgeon.

Upon his entrance into civil practice his alert mind and naturally courageous character were qualities which enabled him to read clearly the signs of the times and to select the path which they pointed out for him. A few surgeons in this country and in England were attempting to overcome the fatalities of ovariotomy, and here seemed to be the opportunity for an adventurous spirit like himself. On his return from Europe he had fully equipped himself with the latest instruments invented for this operation, and it was not long before the list of his cases of ovariotomy began to assume interesting proportions, and he thus became a pioneer in abdominal surgery.

The most prominent of his personal characteristics was courage. This led him from the old, beaten track, and moulded him into a bold and successful operator in an entirely new field of surgery.

Honesty was another striking quality of his character, as shown in frank and virile talk both with his colleagues and his classes.

In active professional work the sterner qualities of his character may have made themselves prominent to the outer world, but among intimate friends there were unfolded charming traits that easily gave him a foremost place among his comrades when he chose to take it.

Although a sufficient period of well-earned repose had been denied to him, Dr. Homans lived long enough to see his ambitions realized, and the new surgery, of which he was so enthusiastic and skilful an advocate, placed upon an enduring basis.

His conversational powers and his happy gift as a raconteur made it possible for him to describe with vivid distinctness many interesting incidents of his varied career. Had his life been spared a little longer, surgical literature would have gained much from a pen which had to bide its time until the knife should be laid aside.

By his death this Association has lost a distinguished member, an enthusiastic supporter, and a loyal friend.

Prof. Dr. MAX SCHEDE,

Honorary Member.

Born January 7, 1844. Died 1902.

Dr. Max Schede was born in Westphalia January 7, 1844. His studies began and were finished in Halle, though during their course he studied both in Heidelberg and Zürich. He took his doctorate in 1866, taking for his thesis the subject "Resection of the Hip." Soon after this began his experiences in military surgery, of course in subordinate capacity. After the conclusion of the war he became assistant in the clinic of von Volkmann, whom he later accompanied to the Franco-German War. From this he returned, decorated with the Iron Cross, to resume his old position, and soon after to become a Docent.

In 1874 he founded, with von Lesser and Tillmanns, the *Centralblatt für Chirurgie*. Three years later, while not yet thirty-one, he was made director of the surgical division of the newly erected Friedrichshain Hospital in Berlin. Five years later, in 1882, he succeeded Martini in the Allgemeine Krankenhaus at Hamburg. In 1888, when the new hospital at Eppendorf was opened he was given charge of the surgical division, where his service included some 600 patients. Hither he attracted so many American as well as other pupils who spread his name and fame, that his clinic became one of the most famous in Europe. While here he was given the honorary title of Professor, and received numerous calls to teaching positions. Finally, in 1895, he accepted a call to Bonn, where he actively taught until his untimely death in 1902.

Much would naturally be expected of one who had enjoyed the teachings of such masters as Blasius, Dieffenbach, Billroth, von Volkmann, and Rindfleisch, and Schede profited duly by their instruction and example, though Volkmann's influence always predominated. A voyage to England gave him and his great teacher a keen interest in the then new antiseptic methods, of which they became ardent exponents, the treatment of wounds long continuing to interest him.

Surgery has Schede to thank for many new methods and improvements of old ones. The treatment of fractures, the use of buried silver sutures, preliminary colostomy before resection of the rectum, treatment of hydrocele by partial resection of the sac with suture of the remainder over the testicle, cuneiform osteotomy for obstinate club-foot and of the tibia for genu valgum with synchronous division of the fibula, ex-

tensive resection of the thorax for empyema—these are but a few of the many measures or suggestions we owe to him, or in which he excelled. In the surgery of the pelvic or of the cranial cavities he seemed equally at home. His schooling under Volkmann accounts for his fondness for orthopædic surgery, especially affections of the hip, to which he made many contributions, and in which he showed rare ingenuity.

With all his astonishing activity in applied surgery, he yet found time to do a remarkable amount of literary work. His monographs upon the *Surgery of the Spinal Cord and Peripheral Nervous System*, on *Amputations and Exarticulations*, on *Diseases of the Diaphragm and Mediastinum*, and on *Injuries and Diseases of the Kidneys and Ureters* exhibit a comprehensive knowledge and a polished style which have made them classics. In their preparation he often allowed himself but two or three hours of sleep out of every twenty-four, so ardently did he labor.

In the perfection of his technique, his attention to minutiæ, willingness to demonstrate to others, interest in his patients, and uniform courtesy to visitors, he was a model for every surgeon, while his geniality and uniform good nature endeared him to all with whom he came into contact. Not alone the wonderful richness of his material attracted visitors to his Eppendorf clinic; no one could visit it without coming away enlightened by his wisdom and charmed by his personality.

ADDRESS OF THE PRESIDENT.

THE CONTRIBUTIONS OF SURGERY TO INTERNAL MEDICINE.

By MAURICE H. RICHARDSON, M.D.,
BOSTON.

In opening the Twenty-fourth Session of the American Surgical Association it is my pleasing duty to thank the Fellows for the honor they have conferred upon me.

During the past year we have lost by death one active member, John Homans. It will be the duty of another to write fully concerning this distinguished Fellow. In him the American Surgical Association has lost a valuable member—a Fellow whose constant attendance added conspicuously to the success of our meetings, whose charming personality made his companionship a delight to anticipate. His large experience, his enthusiasm tempered by wise conservatism, his fearless devotion to truth, made permanent the deep impression of his words and his example.

In my abdominal work I have long been impressed by the frequent occurrence of conditions which were not only new to me, but which were either unrecorded in the books of the times or only briefly described. In the surgical treatment of even the commonest abdominal diseases I have not infrequently found—either directly dependent upon those diseases or indirectly associated with them—lesions of the nature of which I was wholly ignorant. In not a few patients I have found—during explorations made for one thing—other and perhaps more serious things.

In studying the pathological conditions to be met with in many internal lesions, one cannot but be struck by the frequency of such expressions as "Little is known of the pathological conditions of this disease;" or, "Opportunities for investigating this lesion are extremely infrequent;" or, "Death takes place so seldom in the early stages that we can say little of the anatomical changes." Moreover, many conditions are seen of which no mention whatever is made in text-books of medicine, surgery, or pathology. Take a recent instance—in fact, the case of a young woman upon whom I operated the day before leaving Boston to attend this meeting. I felt compelled to open the abdomen for gradually increasing pain and distention. There was an acute double salpingitis, of moderate severity, without general peritonitis. The tubes and ovaries were acutely congested, and there were recent, easily separated adhesions. There was a small amount of clear serum in the peritoneal cavity. The small intestines were translucent, distended, bright red. The radicles of the portal vein were much distended, showing in dark turgid outlines throughout the mesentery of the small intestines, which themselves were spotted here and there, as if by blotches of ink. There seemed a stasis of portal circulation. I withdrew several coils, stretched out the mesentery, traced the veins to the main trunks, and sought carefully for thrombosis or other obstruction. Nothing was found to account positively for the unusual and threatening conditions described. I closed the abdomen tightly, and gave a decidedly unfavorable prognosis. What was the lesion, if any? What the cause of distention? of sluggish or of stagnant portal circulation? What the inference? What the treatment? I have described elsewhere conditions of the small intestines resembling these occurring in the course of a well-established and easily recognized general peritonitis. I had never, however, seen this condition in a comparatively normal peritoneum; and I was seriously alarmed for the safety of the patient.[1]

This is a vivid incident, because a recent one. Many similar ones might be mentioned.

[1] On my return from Washington this young woman was entirely convalescent.

I have, therefore, been impressed by the importance of describing at the time of the operation not only the anatomical appearances of the abdominal disease in question—for these appearances during life are so entirely different from those after death that an accurate description of the latter can aid but little in the interpretation of the former—but also, as far as possible, the anatomy and pathology of accompanying and complicating lesions. Furthermore, the advantages of describing normal appearances in the living is considerable. The skilful operator, it is true, has, from long experience, learned to recognize the normal; the student and beginner will find it hard to tell, even in the living, what is natural and what is unnatural. By study on the cadaver he will learn practically nothing of living appearances.

The importance of early observations of disease in the living surely cannot be overestimated, for not only are deaths infrequent in the early stages of disease, but, when they do occur, permissions for post-mortem examinations are rare. Contrast, for illustration, the pathology of early inflammations of the vermiform appendix, as described in the autopsy-room, with the pathology of these diseases on the operating-table. In the former case early manifestations of disease are found only as unusual incidents in the course of the more serious and fatal lesion, in the anatomy of which, perhaps, the characteristic signs of beginning appendicular disease are overwhelmed.

The opportunity, too, of comparing the slight lesions, say, of early gallstone irritations, with the perhaps obscure and transitory symptoms upon which the diagnosis has been based, cannot but add enormously to our knowledge of the relations between lesion and effect, and make positive the deductions which guide the surgeon's hand.

The demonstration in the course of abdominal explorations of lesions other than that for which the exploration was undertaken gives to subjective signs a weight that nothing else can give. It substitutes for uncertainty, certainty; for inexact knowledge, exact. For example, the discovery of gallstones in the course of an abdominal hysterectomy enables the surgeon to obtain

trivial symptoms of gallstones with an accuracy before impossible.

The opportunity for observation which the surgeon enjoys has added enormously to our skill in the diagnosis and prognosis of internal diseases; it has simplified the indications for surgical intervention; and it has given the physician information of the utmost value in the subsequent medical conduct of the case.

By exerting control surgery has made caution incumbent upon the diagnostician, both in his interpretation of symptoms and in his prognosis; it has enabled him to learn the reasons for symptoms in internal diseases in general, and at their earliest stages in particular; and it has also led him to discredit some, at least, of the ancient and conventional symptoms, which, based upon ignorance, have for generations been handed down from book to book.

Perhaps it would come with better grace from the physician than from the surgeon to say what operative investigation of internal diseases has done in clearing up obscure points of symptomatology, diagnosis, and treatment. The physician, however, sees too little of the actual connection between the conditions which are found at operations and the conditions which precede or follow these operations. It is essential that the physician see as exactly as possible the variations from the normal which are found to explain the history that he has taken and the examination that he has made. In most cases his interest ceases with the diagnosis, to be revived, perhaps, by the actual demonstration at operation or by the autopsy in those infrequent cases in which there is an autopsy. It seems unavoidable, therefore, that the connection between internal medicine and surgery should rest upon the shoulders of those who, by making the actual investigations, verify diagnosis and control opinions.

Until the recent great developments of surgery in all branches of abdominal disease, accurate knowledge of intra-abdominal conditions, especially those of minor severity, was necessarily imperfect. It depended upon examinations made post-mortem. Moreover, these examinations were necessarily made either at the close of the disease process or when that process was at its height.

The anatomical conditions in typhoid, for example, were described as they appeared at the height of that disease, or at the very end of it. The conditions prevailing in the very earliest stages were to be found only in those unusual cases in which death was owing to some unusual complication or some accidental cause. Furthermore, the anatomical appearances in the living had, after death, necessarily undergone changes as marked, for example, as those by which the appearance of the living face differs from that of the dead.

The changes in the gall-bladder and contiguous viscera, in the light of early and careful search, have, perhaps, impressed me more than those in any other field. The attributes of size, shape, and color; the state of distention or of contraction; the presence of attachments to other viscera; the changes in mucous membrane, contents, and ducts—all these things have presented themselves under aspects so new and unexpected that I could not but be impressed by their importance and stimulated to study their significance.

Changes in position, in shape, and in size of internal organs are noted in all works on anatomy. These facts are, nevertheless, derived chiefly from studies of the dead. They may be, and usually are, as true in the living as in the dead; but there are not a few changes marked in the living which would be unobservable upon the dead. Such, for example, are changes in position, owing to posture, of organs which are usually regarded as but slightly movable, and immobilization after death of organs which during life permit considerable displacement. The sagging of the liver in the erect position is an example of the former; the fixation of the kidney by the stiffened paranephric fat, of the latter.

The extraordinary position which a normal liver may take during life I once saw illustrated by the course of a gunshot wound inflicted while the patient was standing erect. There being signs of great hemorrhage, I opened the abdomen at the site of entrance, two inches to the left of the umbilicus and an inch above. The abdomen was filled with blood, which came from a laceration of the right kidney. The bullet, on its way from the point of entrance

to the kidney, which it smashed from hilum to convexity, had perforated the right lobe of the liver. In the recumbent position the wound in the liver was not even suspected; in fact, it was not found until the point of emergence from the liver was accidentally discovered. The right lobe lay in its usual position, concealed by the ribs, and the wound of entrance had retreated far beyond easy detection. In this case, therefore, the liver had sagged below the level of the umbilicus when the patient, in the erect position, received the wound. The intestines and stomach, pushed downward and toward the left, escaped injury. This remarkable variation in the position of the liver was a great surprise to me. It explained at once the apparently extraordinary course which a projectile may take through the abdominal cavity. Though one would hardly expect a gunshot wound of the stomach in the ordinary individual when the wound of entrance was below the umbilicus and that of the exit low down in the back, yet in not a few cases I have found the stomach low down in the abdomen in young and healthy patients, even when the exploration was made in the Trendelenburg position.

I have sometimes found free blood in an abdominal cavity opened for some simple lesion, the source of the blood being apparently a ruptured Graafian follicle. In one or two cases the amount of blood lost was sufficient, with the accompanying pain, to suggest an extra-uterine pregnancy. May not the occasional occurrence of sudden pain and distress in menstruation be accounted for by an unusually large escape of bloody fluid from the ruptured Graafian follicle? It is certainly possible for enough blood to escape into the peritoneal cavity from this cause to suggest either an acute appendicitis or, as I have said, an extra-uterine pregnancy.

In one instance there was blood enough to bulge the dark, undivided peritoneum into the depths of the incision as soon as the muscles and fascia had been cut.

A lesion simulating appendicitis so strongly as to justify laparotomy I have found to be an early tuberculosis of a chain of lymphatics or the very beginning of a typhoid fever.

In a word, I have found in the course of abdominal operations so much that was new to me, that the subject has seemed worthy of presentation at this time.

The appearances observed in the living abdomen vary between wide limits even in health. It would, indeed, be difficult to say that *this* condition of things is the normal, and *that* the abnormal. What constitutes a normal position of the stomach, for example, and what an abnormal one, it would perhaps be hard to tell. The stomach which, emptied of its contents preparatory to anæsthesia, occupies a high position in the abdomen may, when distended after a meal, descend below the umbilicus. How much influence decubitus has on the position of the stomach, how much movements of the diaphragm, how much the weight of food and drink, how much the changes of death—these are interesting and practical problems, in the solution of which not even the best methods of clinical study can compare with those of the operating-table.

An interesting example of the low position that a stomach may assume has very recently come under my observation. The patient, a young, lean, muscular fellow, was at 9.40 A.M. shot in the back over the left kidney; at 12, on account of shock, rigidity of the abdominal muscles, and pain, I opened the abdomen in the middle line. Fortunately for this patient, the bullet had done no damage to the abdominal viscera. There was neither blood, serum, feces, nor gas in the peritoneal cavity; the large intestine was empty. In spite of the patient being in the Trendelenburg position, the lower border of the stomach, tightly distended with food five or six hours after breakfast, was several inches below the umbilicus. Now, this observation, though it might perhaps have been made experimentally by blowing up and percussing the stomach, was a surprise to me. Had I known the exact position of the stomach, I should have been even more impatient to explore. Moreover, had such a stomach been perforated, extravasation could not have failed to overwhelm the peritoneal cavity. The patient had never been aware of any gastric symptoms—indeed, there were none. He was in perfect health; yet his stomach, though not abnormally dilated, was far beyond the limits of its supposed

normal position. Like the liver case just mentioned, the viscus was in a position in which it might have been wounded in the flight of a projectile through an area where no one would have supposed it could possibly have been injured.

Another illustration of the extraordinary variations in position which a stomach may assume was the case of a young woman some years ago in the Massachusetts General Hospital. This patient had had few, if any, symptoms referable to the stomach. She was being treated in the medical wards for some trivial symptoms referable to the abdomen—neurasthenia with dyspepsia. A sudden collapse, with the appearance of an abdominal tumor low in the pelvis, led to my being called in consultation. This tender, suddenly appearing tumor suggested to me an ovarian torsion, for I had seen several suddenly appearing and inexplicable tumors in that area, where none had been either suspected or discovered. The tumor proved to be an acute dilatation of the stomach, for which, lavage proving impossible, a gastroenterostomy was performed by Dr. Mixter. This singular case, showing the extraordinary position which a stomach may assume when apparently not offending in the least, was as much of a surprise to Dr. Fitz as it was to me. The solution of the case was afforded by surgery, for a post-mortem could not be obtained (see *Boston Medical and Surgical Journal*, October 4, 1900).

The opportunities for surgery to contribute to our knowledge of internal conditions (both normal and abnormal) are great. In the Massachusetts General Hospital, for example, the abdominal cavity is explored each year more than a thousand times, and for the widest diversity of diseases.

One of the most important results which, through this vast addition to our knowledge of living conditions, the surgeon in connection with the internist has achieved is the increased skill in the interpretation of clinical histories. Without exact demonstration of the truth, one diagnosis may be as good as another. Surgery affords a verification of opinion, and is the control of diagnosis. No matter how painstaking the observer, how detailed his history, how educated his touch, how logical his deductions,

no diagnosis—except by accurate operative demonstration—can be without possibilities of error. I have learned to look with strong suspicion upon all opinions not based upon opportunities for frequent verification, and with especial disapproval upon opinions adverse to surgical explorations upon the ground of hopelessness. Indeed, except in the most glaring hopelessness, I, for one, would not refuse operation in a doubtful case upon the opinion of any diagnostician. It is easy to say that, if the histories and physical signs are properly interpreted, no case is so obscure that a correct diagnosis may not be deduced; but surgeons know, from very frequent experience, that no diagnostician can always make correct deductions. Even if his deductions are good, his observations may be bad; or if his observations are good, his deductions may be bad. Surgical explorations, I repeat, are establishing facts, and broadening experience is making deductions accurate; in a word, surgery is correcting premises and facilitating conclusions.

"Have we carefully observed all the facts of the case? Yes. Did the art permit of a judgment on the facts under consideration? Yes. Did we reason correctly upon the data before us? No." Thus Osler, in his memories of Traube, closes his valuable monograph on "The Diagnosis of Abdominal Tumors."

It is given to but few to make correct deductions, even if their facts are correct. It is our duty, therefore, to doubt opinions, especially those which condemn to certain death. The art of surgery has been raised to such perfection that it is safer to trust the apparently hopeless case to a surgical demonstration of facts than to base that hopelessness upon fallibility both of clinical observation and of reasoning upon that observation.

Cases without number come to my mind when I recall the errors of diagnosis and of prognosis made by even the most experienced and the most expert, especially in lesions which, fatal through palliation, permit permanent recovery through surgical measures.

I have operated time and again when the facts and the deductions based upon them have been completely wrong, when the medical treatment could only have palliated in its fatal course a

lesion for which surgery offered and gave the most brilliant results. Indeed, there is hardly an obscure case of grave internal disease in which someone does not give a hopeless prognosis and advise against operation. Nevertheless, exploration has shown, perhaps, a pancreatic cyst instead of gastric cancer; gallstones instead of liver cancer; chronic appendicitis instead of intestinal cancer; actinomycosis instead of malignant disease; uterine fibroid instead of ovarian cancer.

Except in extreme cases, all serious internal lesions—no matter how hopeless they appear—permit of some doubt as to diagnosis. Some, indeed, are so evidently malignant and inoperable that there is no doubt—*e. g.*, abdominal tumors secondary to demonstrated cancer elsewhere; hard, movable, irregular masses in the abdomen, with ascites, in adult or late life. When the case is doubtful, however, it is surgical, for all doubtful cases belong in the category of the necessarily operative. Such cases are doubtful because opinions differ. In many cases the agreed upon diagnosis is wrong. Surgery clears the air—it establishes the diagnosis, condemns or saves the patient, and last, but not least, enhances the skill of interpretation.

We have all been impressed by the feelings of doubt with which we present an opinion when the surgeon, knife in hand, asks our final diagnosis. Those of us who have watched the progress of abdominal surgery in the past twenty-five years cannot have failed to observe how, in the declaration of opinions in doubtful cases, certainty has been replaced by uncertainty, overconfidence by modesty. The doubtful case itself, however, has become more and more infrequent, thanks to the frequency of surgical explorations. We have but to contrast the uncertainties of appendicitis, gallstones, and extra-uterine pregnancy, of fifteen years ago, with the certainties of those diseases at the present time, to realize what surgery has done for diagnosis in these grave affections. May we not look forward to the time when obscure abdominal lesions generally may, through surgical experience, be as accurately determined as are the lesions of appendicitis, gallstones, and ectopic gestation?

For myself I have seen, even in the best-understood lesions, errors of the gravest import on the part of both physician and surgeon—errors which, through costly experience, are fortunately becoming less and less frequent. Many of these errors are of commission rather than of omission—typhoid fever, diagnosticated and operated upon as appendicitis; pneumonia and bronchitis (especially in children), in which pain referred to the abdomen has seemed to demand, and has been followed, by an abdominal exploration. It needed but a case or two of this kind, however, demonstrated by the surgeon, to serve as an effectual warning against operation. On the other hand, we have the list of gastralgias, dyspepsias, gastrointestinal catarrhs, and other symptoms in the epigastrium, for years treated ineffectually, until the surgeon has removed gallstones, the appendix, or the mechanical results of gastric ulcer, upon the symptoms of which these false diagnoses were based, and for which worse than useless methods of treatment were for years carried out.

No more brilliant field of reparative surgery than that of gastric ulcer could be mentioned to illustrate what surgery has done in solving one of the most obstinate and unfruitful problems of internal medicine—gastric ulcer, the symptoms of which, so frequently attributed to functional disorders of the stomach, are now known to be caused entirely by mechanical changes, and are relieved so completely and permanently by surgical measures of simplicity and safety.

One can recall not a few cases of annoying and disabling, though not serious, abdominal disease in which a simple and safe operation has resulted in perfect restoration of health after years of needless suffering and ineffective medical treatment. The extraordinary benefits which follow so safe an operation as that of appendectomy in the period of quiescence are conspicuous in all abdominal discomforts, dyspepsias, and colics. Indeed, the number of cases might be indefinitely multiplied in which surgery has proved the dependence of obscure, persistent, disabling symptoms upon so apparently insignificant an organ as the vermiform appendix.

The natural result of the multiplication of explorations in abdominal diseases, both the evident and the obscure, has been to increase the skill of the surgeon as a diagnostician. The internal lesion requiring operation is admitted rather to the surgical than to the medical wards.

The burden of diagnosis has been thrust upon the surgeon in spite of himself. His diagnosis, verified or disproved by operation, teaches him in every case something new for future guidance. He has the best opportunity for acquiring extraordinary skill in detecting the truth of disease.

In exploring for one lesion—and especially so common a lesion as appendicitis—the surgeon could not but widen the sphere of knowledge of the right iliac fossa and of the pelvis. So the right upper quadrant, once explored, could not but present a wide variety of conditions in liver, pancreas, duodenum, and pylorus. To whomsoever belongs the credit of the early explorations of this area of the abdomen, the sequence was inevitable; and so it is with all areas and organs of the abdominal cavity. The explorations, once begun, revealed to surgeons all sorts of conditions and suggested all sorts of remedies.

Not only has surgery contributed to the interpretation of symptoms and histories, to the solution of problems of indication and of treatment, but it has shown the value of aids to diagnosis, the weight to be given to physical examination, to mechanical and laboratory methods of investigation. The value of blood examinations in connection with suppuration, to mention a single example, has been repeatedly shown. It has been shown exactly what weight is to be given to leucocytosis in appendicitis and other abdominal infections—how much positive value there is to the white count and how much negative value. If surgical demonstration has shown that a leucocytosis of 20,000 is valuable evidence in questions of diagnosis and necessity for operation, it has also shown that such a count is of no value except in connection with other symptoms and signs; and if this test by itself has tended to stay the surgeon's hand, exploration in many cases has shown that the restraining influence of a normal white count, in the face of

abdominal symptoms demanding immediate intervention, is disastrous.

Surgery has shown, too, the hollowness of many pretensions to unusual skill in digital examinations by demonstrating the falsity of observations.

One of the earliest facts demonstrated by surgery in connection with many acute abdominal diseases was the hopelessness of medical treatment. A later, but not less important, fact demonstrated by surgery was the needlessness, not to say harmfulness, of surgery in many internal diseases. It has been, and is, the province of surgery to tell what lesions are, on the whole, better treated medically and what surgically. Moreover, it has been the task of surgery to tell under what conditions surgery is demanded, even if these conditions are obscure—what symptoms, in other words, of themselves demand surgical intervention, regardless of the exact lesion upon which those symptoms depend.

The indications for treatment in internal lesions do not always depend so much upon the exact diagnosis of an actual lesion as upon an accurate interpretation of one or more symptoms which in themselves, whatever their cause, threaten life. For example, surgery has taught us that pain may be, and usually is, the most urgent call for exploration which serious lesions make; that he who hears that call for help must heed it before making inquiries as to its exact origin; that he who pauses to investigate the probable cause of pain, while, perhaps, that cause is gravely threatening life, places the less before the more important thing; that the surgeon's first duty is to tide the patient over the crisis of the moment before speculating upon questions of appendicitis, intestinal perforation, or internal hemorrhage. In a word, bitter experience has taught us in acute abdominal emergencies to act rather than to speculate—to respond in the quickest and most direct way to the symptoms calling for relief, whatever those symptoms may be—rather than to lose precious time in trying to determine their exact cause.

As in acute abdominal lesions demanding immediate intervention, so, in less acute lesions or in chronic, surgery has taught

us the value of symptoms by themselves as indications for intervention; but in such cases it permits leisure for careful study and for the weighing of evidence in favor of and against a given diagnosis. It indicates in obscure cases when surgical intervention is desirable, and when medical treatment is preferable to surgical. It has shown, I think, that even in lesions purely mechanical, medical treatment is sometimes better, temporarily at least, than surgical. For example, surgery has demonstrated that certain lesions dependent upon gallstones are best left in the hands of the physician, who by appropriate treatment not infrequently succeeds in rendering gallstones latent until local and general conditions are more favorable for removal.

In the consideration of indications and contraindications surgery has demonstrated the importance of general conditions of body and of mind as influencing the probable result of a proposed operative measure—conditions of body and mind which too enthusiastic advocates of the knife soon proved to be effectual bars against any but the most urgent operations. Lesions which without operation were not necessarily fatal, lesions which under medical treatment promised a few years of comparative comfort, and even lesions which—like cancer of the uterus—permit under palliation only a few months of tolerable existence, and under the most radical and dangerous of operations recovery of very doubtful permanence—such lesions were found to justify radical operations only under the most favorable aspects of general and local conditions. The greater the hope of permanent cure by operation in lesions which are inevitably fatal, and especially lesions attended by great suffering, the less regard was found necessary in scanning contraindications in other viscera or in the general condition. The greater the suffering and the more fatal the lesion, the stronger must be these contraindications to justify non-intervention. On the other hand, the less the hope from surgery, and the less the danger and suffering from the disease, the more insignificant need be the forbidding signs.

Surgery has demonstrated again and again the dangers of operation upon patients with diabetes having pulmonary, cardiac, and

renal complications. They all would contraindicate operation for chronic and mild appendicitis; for gallstones, fibroids, and hernia; but they would not contraindicate operations for gangrene of the appendix or of the gall-bladder, for suppurating fibroid, or for strangulated hernia. For lesions like uterine, gastric, or intestinal cancer, the chance of permanent cure by radical extirpation have been proved far too doubtful to justify so formidable an operation.

In lesions not permitting thorough extirpation, but only palliation, the least unfavorable local or general sign was soon proved to be a sufficient contraindication to operation, and to throw the patient upon the resources of palliative medicine. The lesion itself has, in many cases, through appalling lists of disaster and suffering following operation, proved its own contraindication.

The position which the abdominal disease holds with reference to medicine and surgery is yet far from determined. The tendency has certainly been toward a possible surgical solution whenever the accumulated experience of the past has shown the futility of medical resources. In most diseases it seems already determined whether the best treatment lies in medical or in surgical hands. The number which still occupy the borderland between the two is growing smaller and smaller. Surgery is adding daily its testimony in the solution of these questions.

Evidence, whether medical or surgical, in the so-called borderland case is, perhaps, inclined to bias. Repeated failures in surgical treatment naturally incline to skepticism, unless the circumstances of failure are carefully considered. The results, both immediate and remote, in gastric cancer, for example, are used to deprecate the resort to surgery in that disease. Resort to surgery is, therefore, condemned by some in cancer of the stomach, when, I think, too little attention has been paid to the cause of failure. The surgical treatment of cancer of the stomach—like cancer of the intestine, of the uterus, of the kidney—to promise results worthy of renewed trials, must be applied very early. Failure comes from too late intervention—too late for thorough local extirpation and too late for constitutional recovery. The

diagnosis *must* be operative and not clinical; surgical and not medical. At a recent consultation a physician was opposed to operation in suspected cancer of the stomach because "the evidence of cancer is not strong enough to justify exploration." Surgery has certainly demonstrated that when the physician has waited for the evidence to be "strong enough" to make a diagnosis, the patient may as well continue his medical treatment. The fact is, as I believe we have fully proved, that cancer of the stomach, the uterus, or the intestine is as curable as cancer of the breast, and more curable than cancer of the tongue if the disease is attacked as early in one as in the other. The indications for operation in any form of internal cancer is when the symptoms are beginning, and therefore necessarily obscure, not when they are in the strength of full development and are pathognomonic. As far as suspected malignancy is concerned, the obscure abdominal case is surgical; the plain, surgical or medical, as the case may be operable or inoperable. The disease itself is not necessarily hopeless because it is pronounced hopeless. If surgery has made any positive contribution to our knowledge of internal diseases, it is that no case is absolutely hopeless until exploration has proved it so. Even the case thus condemned may, through errors of direct observation, result favorably—a statement for the truth of which I could bring many illustrative cases.

Surgery, therefore, has contributed to our knowledge the fact that the most positive opinions adverse to operative treatment may be mistaken ones; and, secondly, that an adverse demonstration of hopelessness on the living may be wrong. One feels, perhaps, that to operate upon ultraconservative advice is fully justifiable; and yet one may be, and frequently is, led into regrettable explorations by acting upon such advice against his own judgment. The dictum, "The only chance is surgery: therefore, operate," is a dangerous one; and the greater the surgeon's experience, the less he is influenced by it. Surgeons know that, in the vast majority of desperate cases, and especially in cases of malignancy, there is no chance in surgery, or in anything else. Operation can only injure our art.

Take cancer involving the alimentary tract extensive enough for positive recognition—stomach, intestines, and rectum. But few cases are operable; in but few cases that seem operable do the patients recover; but few patients that recover regain enjoyable health; and but few that regain enjoyable health enjoy it long. A few are, however, permanently cured, or, at least, cured as permanently as breast cancer is ever cured. A few receive, if only temporary benefit, hope in place of despair, and comfort in place of pain. We have not been deluded into glowing anticipations of brilliant results, immediate or remote, in such cases as we have been able to operate upon; and we shall not be, even in the more favorable stages in which we hope to operate in the future; but we have demonstrated to our own satisfaction, if not to that of the internist and of the public, that there is, even in internal cancer, still a straw for the unfortunate patient to cling to and a chance upon which to base a hope of ultimate restoration to health.

In view of the great opportunities which surgery of the abdomen gives us, it is desirable that in all operations careful notes should be made, not only as to the lesion for which the operation was originally undertaken, but of all facts which are directly or indirectly dependent upon those lesions; such observations, for instance, in connection with the surgery of the pancreas as would show the possible dependence of the pancreatic lesion upon the biliary passages; observations upon the size, position, and other attributes of the stomach in connection with operations upon the pelvic viscera; careful investigations of all free abdominal fluids in the uninfected as well as the infected cases, with demonstration as far as possible of the source of free fluids not apparently dependent upon the lesion treated; the occurrence of bloody fluid in the abdominal cavity, and its connection with the ruptured Graafian follicle; the presence and explanation of lymph-nodes of unusual size and unusual number.

Observations upon conditions like the foregoing might be indefinitely multiplied. The accumulated experience of many observers cannot but add facts of the greatest importance in the elucidation of obscure questions connected with internal diseases.

The most interesting line of study in connection with these observations is that of the history subsequent to the determination of the exact anatomical conditions. In a considerable number of cases I have found, in the course of pelvic operations, gallstones in the gall-bladder. In none of these cases was attention directed to the gall-bladder by the history of the case. In three or four of the cases the original operation was a hysterectomy for fibroids. Because of the severity of this operation, I did not feel justified in adding an operation for gallstones, especially as there had been no symptoms attributable to them. The exact condition of gall-bladder as to size, shape, distensibility, thickness, adhesions, and the like was determined digitally, and the facts were recorded. During convalescence the patients were closely questioned for any possible symptoms referable to gallstones previous to operation, as well as subsequent to operation. They were asked to report any symptoms whatsoever observed in the abdominal cavity—any interference with digestion and nutrition. A number of interesting and valuable facts, showing the connection between positive anatomical conditions and subjective symptoms, were thus established. Observations of this kind, multiplied by many observers, cannot fail to throw a strong light upon the now doubtful evidence of early gallstone irritations.

Another interesting problem which such observations will help to solve is the relation between anomalies of digestion and variation in the size, shape, and position of the stomach. As I have previously remarked, the greatest varieties are noticeable in these attributes of the stomach. Even if no special search is made for it, the stomach forces itself into view during many pelvic operations. These changes may be apparently trivial, or they may be marked; but whatever they may be, their influence upon the gastric functions may be great. The connection between anatomical conditions demonstrated at operation and subsequent functional disturbances may be not only apparent, but real. Unfortunately, it is often found impossible to trace subjective symptoms, existing either before or after explorations, to anatomical variations found at explorations. Every surgeon must have observed many strange

things which he never succeeded in accounting for. If, however, he has recorded his observations accurately, the time may yet come when these observations will prove of great benefit to the patient. Indeed, I have often advised the attending physician to direct his treatment to this or that organ, the abnormalities of which I have accurately noted.

Among common variations I have already spoken of the stomach. Another frequent variation from the normal is in the shape and size of the large intestine. In many cases of abdominal pain—whether diagnosticated as an appendicular colic, a movable kidney, or an ovarian neuralgia—I have found a distended, elongated, and tortuous colon. It seems reasonable to conclude, especially when the appendix fails to present marked evidence of disease, that the condition of the colon may better explain the pain. After operation, therefore, special attention may be paid to the treatment of the large intestine, even if the treatment before operation had been, though ineffectually, directed to that condition.

A valuable source of information to the clinician lies in the comparison during life between physical signs described and recorded before operation and those demonstrated and recorded at operation. The surgeon thus proves to the physician the value of his physical examination.

In chronic intestinal obstruction, for example, it is of great importance to locate exactly the seat of the obstruction. Painstaking observations are made by means of injections, the amount of fluid borne without too great pain being the measure of intestinal tract below the disease. I have time and again demonstrated that this method of locating an intestinal obstruction is unreliable. It may not only indicate a false situation of an actual stricture, and put the surgeon on the wrong track, but it may show an obstruction when none in reality exists. In a recent case, after the physician had made an exact localization of the seat of stricture by rectal injections, I was unable at exploration to find any obstruction, either at the place indicated or anywhere else. I was not surprised at the result; for there were, in my opinion, no reliable signs of intestinal obstruction.

Surgical explorations have created a spirit of healthy questioning whenever positive deductions have been drawn from uncertian methods of physical examination; and yet, while explorations for chronic intestinal obstructions have often proved certain tests untrustworthy, they have given perfect confidence to other tests. Take the same lesion, intestinal obstruction; violent and repeated intestinal spasms, with visibly contracted and prominent intestinal coils, have been proved by many an exploration absolutely pathognomonic of obstruction, whether the spasm be of stomach from pyloric stenosis, or of colon from cancer of the sigmoid. What surgery has not been able always to show, however, in the absence of tumor, is the seat of the stricture from the situation and size of the visible coil; for in slowly narrowing strictures the proximal coil may become so excessively distended as to make a distinction between large and small intestine impossible. Moreover, the distention and spasm in time displace the affected coils, so that an accurate localization is, from them alone, impossible. Surgery has shown the seat of intestinal sounds and their direction to be much more reliable than any other sign.

Examples might be multiplied indefinitely tending to show how surgery, from an enormous mass of raw material, has brought about a gradual evolution of sound physical evidence in the diagnosis of internal disorders. The surgeon has taught, perhaps, what *is not* good evidence more effectively than what *is*. If he has shown the physician that his tactile conclusions are not always to be relied upon, he has taught the same lesson to himself and to his colleagues. If he has taught himself to believe that he can always palpate a normal appendix, his colleague has, time and again, by demonstrating the fallibility of his touch, taught him that he cannot.

In view of the great opportunities for good which the surgeon possesses in his numerous explorations of internal lesions, it is incumbent upon him to make as careful observation upon the intra-abdominal conditions as time and the interests of his patient permit. He should observe and record not only what he sees and feels in the area necessarily exposed, but what he can detect by

touch in the remoter regions of the peritoneal cavity. These examinations add no more to shock than those which duty requires him to make in accounting for his gauzes; they are demanded in many cases for complete and thorough accomplishment of his operation, and in many for appropriate after-treatment; they are necessary in many instances for an adequate explanation of the history. In many cases, after an apparently complete operation, a lesion will be found upon which, more than upon that already remedied, will depend recovery. Careful search for every possible explanation of symptoms is, therefore, imperative, especially in obscure cases, lest the patient, unrelieved by the first operation, be brought reluctantly to a second. When after the failure of an appendectomy to relieve symptoms the patient is subjected to an ovariotomy, and later dies from an operation for gallstones, the question cannot but occur, both to the surgeon and to the friends, that perhaps, after all, the order of intervention should have been reversed, and that a successful gallstone operation might have obviated the others; or, better still, that all three operations should have been performed at one sitting.

It is, however, always to be regarded as a matter of experience and common sense just how much in a given case a patient can with safety withstand. In some cases a moment's additional delay, the slightest additional shock, is sufficient to turn the scale. Under such circumstances all manipulations not absolutely essential to the actual emergency must be omitted. In localized sepsis no explorations beyond the affected area are permissible.

Finally, it is the duty of the surgeon, whenever with the foregoing limitations he can do so, to find by thorough examination an adequate explanation for existing symptoms. After operation he should try to establish, by careful study of symptoms, the way in which known lesions in their earliest symptoms manifest themselves.

Accurate and detailed records of everything done and found should be kept for future aid to the physician in giving best help to the patient.

The surgeon, then, in his opportunities for observation and study, has contributed vastly to our knowledge of internal disease,

especially in its early stages. His explorations demonstrate truth and control opinions; they perfect observations, and, in showing the value of deductions, teach their weight; they prove the interdependence of symptoms upon lesions, and of lesions upon symptoms; they demonstrate the falsity of some inferences and the truth of others. Accumulated experience will show these things so clearly that in time the diagnosis of the clinician will approach the accuracy of scientific demonstration. In therapeutics surgery has shown what surgery can do and what it cannot do, as well as what medicine can and cannot do. Surgery will show still more clearly its own limitations, as well as the limitations of clinical medicine. Working together, they will contribute so much to our knowledge of internal diseases that it seems not impossible that in the near future there will be no borderland between them. It will then have been demonstrated that internal diseases, even some of those now regarded as hopeless, will, by surgical or by medical therapeutics, or by both, be relegated to that class of brilliant achievement to which now belong appendicitis, gallstones, and internal hemorrhage.

THE TOILET OF THE PERITONEUM IN APPENDICITIS.

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In selecting the best method of performing the toilet of the peritoneum in operative attacks in cases of appendicitis, the surgeon will be guided largely by the condition of the peritoneum itself. From this point of view, the subject under discussion may be divided into the following:

1. Cases in which no peritonitis is present.

2. Cases in which the infection of the peritoneum is present, but confined to the immediate neighborhood of the appendix.

3. Cases in which the pelvis is the seat of a seropurulent collection.

4. Cases in which the peritoneum and enteronic areas are the seat of infection (more or less generalized septic peritonitis).

5. Cases in which the entire peritoneum, pelvic, enteronic, and diaphragmatic is involved (diffuse septic peritonitis).

1. *Cases in Which No Peritonitis is Present.* Here the whole matter resolves itself into methods of protecting the peritoneum from infection during the opertion, the details of which need not be entered into in this connection. It should be borne in mind, however, that whether the operation be undertaken during the period of quiescence or during an attack, yet, while the infection is still confined to the appendix, the mere fact of the removal of the latter involves opening the intestinal canal and the exposure of the peritoneum to infection from this source. It may therefore happen, from some awkwardly executed movement in the manipulation or other cause, that the peritoneum may become infected

from the intestinal canal and render necessary a more than mere protective treatment of the peritoneal cavity.

2. *Cases in Which Infection of the Peritoneum is Present, but Confined to the Immediate Neighborhood of the Appendix.* Cases in this class may be subdivided into (*a*) those in which adhesions are present without suppuration; (*b*) those in which adhesions and suppuration are both present; (*c*) those in which neither adhesions nor suppuration are present.

In the first two subdivisions in this class a tumor will usually be felt before entering the abdomen, and the surgeon's first care upon opening the cavity of the peritoneum will be to safeguard the peritoneum by introducing gauze pads in such a manner as to "pack off" the portions still free from infection. I have not the fear of sublimate solutions in the peritoneal cavity held by some surgeons and do not hesitate to saturate these gauze pads with a 1:2000 solution of mercuric chloride. It frequently happens that a sudden gush of horribly foul and infectious material takes place as adhesions are separated in approaching the appendix. This sometimes occurs with such force and in such quantities as to rapidly fill the gauze pads and even pass through and beyond these before it can be wiped away. In view of this it is only rational that an attempt be made to deprive this material of its highly infectious properties to an extent, at least, by contact with the sublimate as it filters through the pads. I have never seen harm result from the presence of the sublimate, and I think I have seen instances in which this precaution has prevented the spread of infection. If no pus is found a simple sponging of the cavity in the adhesions in which the appendix lay, after the removal of the latter, with hydrogen dioxide, afterward cleansing this away with sterile salt solution, completes the toilet of the peritoneum. If pus is present this should be carefully removed by means of rapid sponging, the septic cavity from which it escaped treated with hydrogen dioxide, and the task of removal of the appendix proceeded with then, and then only. After the removal of the appendix the question of drainage will come up. This should be decided in each case in accordance with the conditions present. If there be no perceptibly septic conditions remain-

ing, such as sloughing adhesions and slate-colored patches of lymph in the neighborhood; if the stump of the appendix or the opening in the cæcum from which it has been removed is well secured, the walls of the latter permitting the application of a purse-string suture or other trustworthy means, then thorough cleansing may be followed by immediate closure without drainage. If, however, the surgeon has any doubt upon either of the points mentioned, he should drain. The point selected for the drain to emerge, however, should not be through the wound in the anterior abdominal wall, on account of the risks of subsequent ventral hernia which this involves, but, laterally, just above the crest of the ilium and well in front of the line where the lumbar fascia joins the internal oblique and transversalis muscles. This will bring the point of emergence of the tube about on a plane half-way between the anterior superior spine and the highest point of the ilium. The track for the tube is made by a stab cut from without; the point for the entrance of the knife within is located by a finger in the peritoneal cavity, which also protects the colon from injury. Before withdrawing the knife a narrow forceps is passed along its blade and in the jaws of this a finger-sized rubber tubing is grasped and drawn into position. The inner end of the tube should project slightly beyond the peritoneal surface. A narrow strip of sterile gauze should be passed through the tube, its inner end resting in the septic space. The outer end of the tube and contained gauze drain should be dressed separately from the wound in the anterior abdominal wall.

When pus is present the patients should be treated in the above manner, particularly if the pus is very offensive or large in quantity. Cases in which localized peritonitis is present, with neither adhesions nor suppuration, usually do well with removal of the focus of infection, cleansing of the region in which the appendix lay, and immediate closure. This is particularly true if neither gangrene nor perforation of the organ is present. The risks attending the occurrence of the first named are considerable and the attending peritonitis may be slight, moderate, or intense. In either case the damage which has already been done cannot be undone, and, with the removal of the appendix and cleansing of the surroundings, the

peritoneal cavity may be closed. The more manipulation exercised at this time beyond that which is absolutely necessary, the more harm will be done, and no amount of drainage will control the spread of the peritoneal inflammation. Much harm may have been done by attempting to pass strips of gauze between coils of intestine in the effort to drain localities in which no fluid exists. The most rational course to pursue under these circumstances is to close the peritoneal cavity when cleansing has been effected, and that without drainage.

In cases of perforative appendicitis, the peritoneal cavity being unprotected by adhesions, practically the same course may be followed. Here, as well as in the case of a gangrenous appendix, isolation of the non-infected area during the operation should be practised. The use of the gauze pads is a necessity, and thoroughly wetting these with sublimate solution adds an additional element of safety. When a perforated appendix is found floating free in the peritoneal cavity search should be made for fecal masses or concretions in the neighborhood. With removal of the source of infection and local cleansing the surgeon has reached the limit of his endeavors so far as the toilet of the peritoneum is concerned. Unless doubt exists as to the closure of the cæcum or the integrity of the intestinal wall at this point, the indications for drainage are not present, and this step should be omitted.

3. *Cases in Which the Pelvis is the Seat of a Seropurulent Collection.* It occasionally happens that a seropurulent collection is present in the pelvis in addition to a similar collection immediately surrounding the appendix. It is usually manifested by a sudden gush following the giving way of adhesions between coils of intestine, in the direction of the pelvis in the course of the manipulation, when there was no evidence of its presence previously. After carefully cleansing the original focus following removal of the appendix, a small bunch of gauze in the grasp of a forceps passed over the iliopsoas muscle and into the pelvis will detect such a collection. Once its presence is detected it should not be ignored. It is to be removed by repeated yet gentle sponging with gauze, the intestines being carefully held away from the pelvic brim and the surgeon's

finger guiding the forceps grasping the gauze to prevent damage to the intestines. Following its removal a good-sized glass drainage tube is passed into the pelvis close to the iliopsoas muscles and into this equal parts of a fifteen volume solution of hydrogen dioxide and a saturated solution of carbonate of soda are poured. A portion of this is forced out of the tube by means of a piece of gauze grasped in a hæmostatic forceps acting as a piston to cleanse the surroundings. In the male this tube is allowed to remain for twenty-four hours, or as long as more than a drachm of fluid is aspirated therefrom each two hours. This tube is dressed separately and not included in the abdominal dressings and binder. I have known such a tube to be forced upon and produce perforation of the rectum from neglect of this precaution. In females drainage may be advantageously made through the cul-de-sac of Douglas and into the vagina with a rubber tube.

4. *Cases of More or Less Generalized Septic Peritonitis.* By the term "general peritonitis" is to be understood infection of both the pelvic and enteronic areas. The involvement of such a large portion of peritoneal surfaces brings the surgeon face to face with a very serious condition, and operators differ somewhat as to the course to be pursued in making the toilet of the peritoneum under these circumstances. Most patients in this condition do not bear operative shock at all well, and in general terms it may be said that the less done beyond the immediate requirements of the case the better, namely, the removal of the primary focus of infection—*i. e.*, the appendix—particularly in that class of cases in which the peritoneum presents a coppery hue and but little, if any, fluid is present. In this class of cases the surgeon should feel that he has accomplished much when he has rid the patient of the source of the sepsis, and rest content with this. Here and there he will encounter a case in which intestines considerably reddened, or even but slightly so, will be seen floating in a milky fluid. In this class of cases the patients are, as a rule, not in so desperate a state as those last mentioned, and something further may be attempted for them. It has been my practice in recent years to gently insinuate the point of a Chamberlain tube between the coils of intestines in

the direction of the liver and spleen successively, and irrigate the abdominal cavity with warm saline solution. Considerable force is given to the stream by employing a very large tube and rubber-hose connection and elevating the reservoir to a height of eight feet or more. Large quantities, sometimes as much as six gallons, are used. As soon as the fluid returns clear from one place the Chamberlain tube is changed to another, until all parts are as clear as they can be made by flushing. It is not claimed that the cavity of the peritoneum can be thoroughly cleansed by this process, but it is made relatively clean, which is some gain. Again, as much of the saline as possible is left in the cavity, which serves the twofold purpose of diluting the infection which remains and inviting a rapid peritoneal leucocytosis, than which no better bactericidal effect can be obtained.

Eventration for the purpose of more thorough cleansing does more harm than good, and the so-called "scouring" method of ridding the intestinal coils of patches of plastic lymph is to be mentioned only to be condemned.

Finally, as I have heretofore described and practised,[1] there is something to be gained in this class of cases by placing the patient in a position to take advantage of gravity in causing the fluids in the peritoneal cavity to flow to the pelvis, and at the same time to antagonize the action of the diaphragm in attracting fluids to the upper part of the peritoneal cavity. The large stomata of the enteronic and diaphragmatic areas, which open out of the enormous lymph sac which constitutes the cavity of the peritoneum, are not readily closed by the coexistent septic lymphangitis, and their permeability to the passage of septic fluids leads to a transference of these to the circulation with resulting distant infection or general intoxication, or both. On the other hand, the gravitation of these septic fluids into the pelvic cavity results in an environment unfavorable to their absorption. The anatomical peculiarities of the pelvic peritoneum with its capillary lymph vessels is such that, as is well known, septic conditions of the most pronounced character may exist for a long time without grave danger to the indi-

[1] Medical Record, vol. lvii. No. 15, p. 617.

vidual. These anatomical points have been so well brought out by Byron Robinson[1] that it is unnecessary to dilate upon them here.

5. *Cases of Diffuse Septic Peritonitis.* Cases in which apparently the entire peritoneum, pelvic, enteronic, and diaphragmatic, is involved, come under the head of diffuse septic peritonitis. It is probably true that the entire peritoneum is not necessarily infected in these cases, but the fact that all three of the areas mentioned are involved suggests the term "diffuse." The toilet of the peritoneum in cases in which this condition is due to appendicitis consists of removal of the septic focus, as thorough local cleansing as the circumstances will permit, the introduction of a glass drain into the pelvis, and rapid closure of the peritoneal cavity; these constitute the measures with which the surgeon must content himself in the majority of cases. Exceptionally, a patient may be presented in whom all three of the areas mentioned are involved in the infection, and who still may have retained sufficient vitality to justify the surgeon in proceeding farther and flushing the peritoneal cavity with the Chamberlain tube and forced irrigation. Even the most favorable of the cases in this class do not bear the shock of intraperitoneal manipulation well, and whatever is done for them must be done as quickly as possible. But haste must not be permitted to give rise to rough manipulation or otherwise careless work. A patient with diffuse peritonitis of appendicular origin who survives after eventration is employed to assist in the cleansing of the peritoneal surfaces would have recovered without this aid. On the other hand, the promptness with which patients have died following this manipulation in my experience suggests to me that this has had something to do with the rapid death, and that the patients would have had an equally even, if not better, chance for recovery without the additional shock which this measure entails. Whether flushing is resorted to or not the employment of the elevated head and trunk position, provided too much work is not thrown upon the heart by its use, assists in encouraging the passage of fluids in the upper peritoneal cavity to the pelvic area.

[1] Annals of Surgery, vol. xxxi. p. 214.

To sum up the subject of the toilet of the peritoneum in appendicitis cases the following propositions may be advanced:

1. In cases in which the infection is confined to the appendix the surrounding peritoneum should be carefully guarded against infection from the opening left in the cæcum by the excision of the organ.

2. In cases in which suppurative collections are present the cavity of the peritoneum should be carefully guarded by gauze pads, which may be advantageously wetted with a 1:2000 sublimate solution before breaking down limiting adhesions in approaching the appendix.

3. As soon as a pus cavity is opened the septic material should be rapidly sponged away and the neighborhood cleansed with hydrogen dioxide. Following this the appendix should be removed, after which the parts are subjected to a second cleansing process.

4. Outlying infection of the peritoneum may, as a rule, be left to take care of itself after the removal of the appendix and local cleansing.

5. In peritonitis more or less generalized in the pelvic and enteronic areas the method of procedure will depend upon the presence or absence of markedly septic seropurulent material. When the latter is present it should be carefully sponged away. If only thin and slightly turbid, this will usually suffice. If, however, this is more decidedly purulent, and particularly if flakes of grayish, slate-colored lymph are floating about in it, providing the patient's condition will permit of it, the infected area may be forcibly flushed with saline solution and drained from the direction of the pelvis, the force of gravity being utilized in the after-treatment to encourage the flow of septic fluids from the enteronic to the pelvic area.

6. In diffuse septic peritonitis the conditions are usually such as to prohibit prolonged interference, and the surgeon will, in the majority of cases, be justified in interference only to the extent of removing the appendix and cleansing locally. In selected cases flushing the peritoneal cavity has advantages. The elevated head and trunk position should be employed in the after-treatment whenever possible. Favorable results from eventration can only

rarely be claimed legitimately. So-called "scouring" of the peritoneal surfaces for the removal of plastic lymph is a most unsurgical procedure.

7. Drainage, when instituted, should be by glass or smooth rubber tubes. Massive gauze packing or multiple and radiating gauze strips placed between the intestinal coils is probably never of real service, and may be productive of harm.

OPERATIONS UPON THE STOMACH, WITH SPECIAL REFERENCE TO THE TOILET OF THE PERITONEUM.

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There is probably no portion of abdominal surgery in which a surgeon of my age has so much to be thankful for, and to feel grateful in regard to the work accomplished by our profession, as in the progress that has been made in the various now recognized operations upon the stomach. Of the success attending this line of work I feel I am asserting the truth when I state that it is largely due to the care that has been exercised, more especially of late, in the toilet of the peritoneum.

Operations upon the stomach are so varied and at the present time such a well-recognized procedure, becoming more and more so, not only by the general practitioner, but by the public at large, that while we have the serious factors that enter into this work, such as the exhaustion of the patient who has allowed the favorable opportunity to pass by, when emaciation is too apparent, when the nerve centres are so exhausted that the operation becomes very much more difficult; yet, withal, we must ever bear in mind the necessity of sufficient time being afforded, in doing the operation selected, to carry out carefully the technique of the peritoneum and help to avoid the dangers that may result from imperfect drainage later on.

The technique of the peritoneum begins even before the abdominal incision is made. I do not refer to the preparation of the patient, but more especially to the diagnosis that has previously been reached. In the correct diagnosis much depends upon the

work to be done within the abdominal cavity and the handling of the contents. Traumatism of the peritoneum is to be avoided as much as possible. The length of the incision is of importance. If the lesion has been correctly diagnosed there is a vast difference in dealing with a simple ulcer, no adhesions, and one in which the chronic history indicates firm adhesions and many complications. In the former there is little exposure of peritoneal surfaces and a short incision is permissible; in the latter a long incision becomes necessary and much more erosion of this delicate membrane is called for. There is much in the method of examining the contents of the abdominal cavity when once the latter is opened into. I cannot believe that it is always wise to bring everything out for macroscopic examination, unless it is absolutely necessary. There is no gauze, no wet towel of any material, nor normal or artificial sponge but that will do some harm to the peritoneum. It may not be in the actual bruising or tearing of tissue. Handled ever so carefully, an element of shock is introduced that can sometimes be eliminated; therefore, when a reasonably certain diagnosis leads the surgeon to think that a short incision will answer, let him make use of it.

Again, on the other hand, if indications are such that a long incision is likely to become necessary, let no great amount of time be lost in making it. I am strongly impressed that we should fix in our minds methods of examining the pathological lesions that may be present; that is, the more expert we become in examining conditions within the abdominal cavity—for instance, not lifting the stomach out through the incision if it can be avoided—the better. Each of us can probably call to mind the attitude of our anæsthetist, as follows: When working within the peritoneal cavity all has gone well, but as soon as we begin traction to deliver the mass he has quietly said, "The patient is not doing so well," and if at any point posteriorly the peritoneum is torn, as sometimes occurs with the gentlest manipulations, the shock is more marked. I am constrained to say—when, for instance, we are attacking the stomach and feel somewhat in doubt as to our diagnosis, and at once realize that our examination is likely to be prolonged—that it

is good surgery to block off the cavity, holding the intestines well away from the field of operation by means of gauze veils, and not have any more of peritoneal surfaces brought outside or exposed than is absolutely demanded. I do not think soiling the peritoneum with fresh blood or healthy bile is particularly dangerous, but the contents or secretions from other mucous surfaces should be carefully avoided. Feces, gastric secretions, pancreatic fluid, infected bile, urine, and all foreign substances are fruitful sources of infection of the peritoneum, septic very likely in its results.

Therefore, when once we resolve to do any operation that is to involve the continuity of the peritoneum, we should protect peritoneal surfaces with great care.

In doing resections of the stomach, intestinal tract, or similar operations, I am more and more impressed with the importance of bringing peritoneal surfaces in contact with each other with as little exposure of underlying tissues as possible.

The peritoneum is very choice in its associations and does not tolerate well being brought in contact with anatomical structures differing in development and growth.

When leaving the peritoneal cavity cleanliness should be observed in every respect. If the contents of the hollow viscera have escaped, here we are justified in mopping out as carefully as possible peritoneal pockets and surfaces. Undoubtedly in some cases the cleansing with hot normal salt solutions becomes necessary, but great care should be exercised that we do not carry offensive material to other peritoneal surfaces to do postoperative harm.

Special attention should be given to the peritoneum in the operation of gastrectomy, covering the denuded surfaces, particularly when there has been a free dissection of lymphatic glands and anatomical structures posterior to the stomach, and great care should be exercised in bringing together the surfaces of the peritoneum as cautiously as possible. If this latter is not possible, then such cases are proper for careful consideration as to drainage.

One cannot well speak of the toilet of the peritoneum without referring to drainage. I am satisfied that when we are operating in the neighborhood of the posterior wall of the stomach, either for

relief of pathological conditions or the repair of traumatisms, we must ever have in mind that there is danger of an oozing—serous, bloody, or otherwise—and that we ought, in a few cases, to do a posterior drainage directly up through the lateral walls or through the peritoneal pouch on the right side, or in some manner to establish a perfectly aseptic outflow of material that may accumulate and otherwise do great harm. Various forms of gauze drainage may be employed, and will continue to be used by certain operators.

In closing the wound, and when I realize that there has been a large surface of the anterior wall of the stomach included in the sutures, I am frank to say that I always feel easier to bring it close up under the abdominal wound, put in drainage of gauze, to be left for one or more days, and have no reason to regret having done so.

A combination of gauze, glass, and non-compressible rubber drainage is desirable at times when protecting the peritoneum.

We must ever remember that the peritoneum is our great friend up to a certain point, but if overcome in its phagocytic work, then it becomes exhausted and no longer aids us in the recovery of our patient. We must keep it in a healthy, normal condition, if possible.

In all our operations proper attention should be paid to the warmth of the peritoneal surfaces and no sudden chill or exposure to cold permitted.

In the toilet of the peritoneum the subject of the selection of ligatures will continue to absorb our attention. My own preference—perhaps this is due to my early education—is in the direction of as fine silk as can be used, although catgut is employed by some surgeons with success. I am always distressed when I see or hear of anyone using chromicized catgut. Buried sutures of silver wire I seldom find to be necessary.

THE TOILET OF THE PERITONEUM IN TUBERCULOUS PERITONITIS.

By A. J. OCHSNER, M.D.,
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In reviewing the literature upon the surgical treatment of tuberculous peritonitis in connection with a study of my own clinical cases, I have been most forcibly impressed with some facts concerning the toilet of the peritoneum in these cases.

All observers seem to agree upon the fact that recovery resulted in a very large proportion of apparently hopeless cases, in which the operation was performed because of a wrong diagnosis. In almost all of these cases virtually nothing was done except opening the abdominal cavity and closing it again immediately, or simply inserting a drainage tube for a few days. This experience was, of course, contrary to the expectation of the operators in most of these cases. The early observations in this direction of Spencer Wells, Koenig, and others have been repeated constantly by every abdominal surgeon.

In my own experience I have been especially impressed with the fact that the recoveries were most common in cases of long standing, in which internal treatment had been of no benefit; more particularly if the fluid was encapsulated because of the surrounding adhesions. This condition has frequently been mistaken for an ovarian cyst.

This observation is borne out by the experimental work of Gatti and others. These observers found in their experiments upon animals that if the tuberculous process in animals had existed for a long time before the operation this fact favored the healing process to a marked degree in cases treated by simple abdominal section.

Watson Cheyne and others have dwelt upon this fact in connection with their clinical observations.

I also found that many apparently hopeless cases recovered perfectly when nothing was done except simple incision and drainage, while other similar cases succumbed in which a more thorough operation was performed, consisting in the removal of considerable portions of tuberculous tissue.

During a period of several years it seemed as though a surgeon could not conscientiously leave great quantities of tuberculous tissue in the abdominal cavity after the latter had once been opened. Thoroughness had become habitual in all forms of surgery, but in my own experience the results became less and less satisfactory with the increase in this thoroughness. In comparing parallel cases I found that those patients in whom practically nothing was done except drainage regularly recovered rapidly and permanently, while others in which more was done either succumbed or made a slow and unsatisfactory recovery.

In reviewing the literature it also became plain that surgeons who insisted upon thoroughness in these operations had most unsatisfactory results. Many of these authors, like Fenger, went so far as to discredit the surgical treatment of these cases altogether, I believe chiefly because their efforts at thoroughness seemed to be of harm rather than benefit to the patient.

The observation made by Lawson Tait, that drainage, irrigation, and medication of the abdominal cavity in these cases are not only useless but actually undesirable, and that the simpler the operation performed the better the result, seems to be borne out thoroughly, not only by my own clinical experience, but also by a review of the literature. In my personal experience recovery has been somewhat more rapid and permanent in cases in which a glass drainage tube covered with iodoform gauze was inserted into the cul-de-sac of Douglas and withdrawn as soon as it ceased to drain. Mayo, who has a very large experience in the treatment of this class of cases, favors the immediate closure of the abdominal cavity without drainage after emptying the fluid.

The peritoneum in these cases is so fragile that it seems impos-

sible to utilize it for plastic purposes, and in cases in which I have attempted this I have always regretted it, because it seemed to prepare a surface through which septic absorption could most easily take place. For the same reason the separation of adhesions is bad practice. Indeed, it is doubtful whether any interference whatsoever is indicated in any case in which the tuberculous peritonitis is accompanied with the accumulation of fluid in the peritoneal cavity.

One year ago I tabulated all cases of tuberculous peritonitis which I had operated in one hospital, showing the immediate and late results. Since this time I have operated upon eight further cases in the same institution. This number is of course too small to warrant positive conclusions, but, taken in connection with the literature upon the subject, they seem to warrant the following conclusions concerning the toilet of the peritoneum in these cases:

1. In the absence of ascitic fluid in the peritoneal cavity the diseased tissues may be removed with safety if the section is made entirely in healthy tissue.

2. In the presence of ascitic fluid the latter should be evacuated and the abdominal cavity drained.

3. Great care should be exercised in making the intra-abdominal examination not to cause any abrasions.

4. Adhesions should not be disturbed.

5. The less the tissues are manipulated the better will be the results.

6. Manipulations of the infected pelvic organs—uterus, ovaries, and Fallopian tubes—are less harmful than manipulations of the infected intestines.

ON SEPTIC THROMBOSIS OF THE ROOTS OF THE PORTAL VEIN IN APPENDICITIS AND ON PYLEPHLEBITIS, TOGETHER WITH SOME REMARKS ON "PERITONEAL SEPSIS."

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Nosology. Though septic phlebitis of the veins holding close relations to a focus of progressive bacterial infection is one of the regular stages of the process of tissue death and disintegration, the remarkable fact remains unchallenged that, fortunately, in the vast majority of cases, natural provisions prevent the detachment of septic thrombi and their importation into the portal or systemic circulation. The minute detail of the manner in which the demarcation and limitation of an infectious process is accomplished *within the lumina* of those veins which contain septic thrombi is not sufficiently well known and needs further elucidation. Studies extended to this field may give us an adequate answer to the question, Why do certain thrombi become detached to be carried into the circulation as emboli, and why is this accident not more common?

Septic pylephlebitis is caused by the detachment of thrombi formed in the roots of the feeders of the portal vein which drain all the abdominal viscera, beginning from the cardia down to the anus, including also, either directly or by numerous anastomoses, the bladder and the female generative organs. Its most common cause is to be found in appendicitis.

Most authors consider the disease to be rare. Ralph Thompson,[1] on the other hand, believes it to be comparatively frequent.

[1] Pylephlebitis and Liver Abscesses following Appendicitis. Boston City Hospital Reports, 1902.

The author's experience, based on the observation of 1189 cases of appendicitis operated on at Mt. Sinai Hospital in the last ten years (beginning from 1892), bears out the former assumption. We have seen the disease nine times only.

Compared with the brilliant showing surgery can make in its success of coping with the various inflammatory disorders of the appendix and their grave consequences, notably with local or a more or less diffuse peritonitis, this, the gravest of all possible complications of appendicitis, still remains a "partie honteuse" of modern practice.

The rarity and the utter hopelessness of the malady have, as it seems, prevented the development of a copious literature bearing on the subject which, viewed from the therapeutic standpoint, seems to be one of the most inapproachable and uninviting.

Studied on the post-mortem table, the various forms of septic thrombosis of the portal vein and of its feeders can be grouped as follows:

1. *Continued Thrombosis.* The primary thrombus is seen extending gradually and continuously or, in short intervals of space, upward toward the centre, rarely involving the entire circumference of the lower course of the portal vein, but more commonly forming laterally adherent thrombi, alongside of which the blood current may still pass with little interruption. Completely obturating thrombi are generally found near and about its entrance into the liver, either in the trunk of the portal vein, which is rare, or more commonly in one or the other, or in both of its branches. The process of infection is a slowly progressive one, *by continuity*, and results in the formation of a more or less extensive septic thrombus of unequal mass and thickness and of varying consistency.

2. *Detachment of Thrombus. Embolism and Septic Invasion of the Systemic Circulation.* The detachment of a septic thrombus is determined by these several factors:

(*a*) Lack of firm adhesion of the thrombus to the walls of the vessel.

(*b*) Loss of consistency of the thrombus due to septic deliquescence.

(*c*) Mechanical forces acting from within or from without the body, which by lateral pressure loosen an adherent thrombus, break it up into fragments, and propel them toward the point of least resistance. Proportionately to the greater or lesser degree of solidity or deliquescence this propulsive effect of mechanical pressure will be more or less pronounced. Mechanical pressure may result from the contraction of the muscles—iliopsoas and abdominal walls—of the patient's body, or may be applied from without by a blow, by massage, or by the manipulations accompanying a surgical operation. A concussion of the body, as in a fall, may also effect the detachment of certain thrombi. Finally, the changing of the blood currents, caused by the intravenous change of the hydrostatic conditions in the affected area by incision and evacuation of an abscess, may also be sufficient to detach a broken-down thrombus. (See case of Miss Hannah A., page 46.)

Examining the thrombi themselves on the post-mortem table, we have found great differences in their consistency and divisibility. Some had the elastic solidity pertaining to freshly coagulated blood, which is not easily broken up into fragments; others represented a shell of a more coherent, somewhat discolored material within which was contained a pasty, creamy, and viscid or an almost fluid purulent emulsion, approaching the character of thin ichor.

It is evident that these varying physical peculiarities of the thrombi must in an important way exert their influence both upon the manner by which a detached thrombus becomes an embolus and also upon the subsequent history of the detached material.

Let us now consider in what manner the pathological processes due to septic embolism will be influenced by the consistency and corpuscular size of the detached thrombotic material.

In *continued thrombosis*, as we have seen, the extension of the thrombus is by accretion, mostly in a centripetal direction. Occasionally, however, this growth may extend centrifugally, when the thrombus of the main trunk occludes the orifice of an inosculating branch. Usually, the process is a comparatively slow one and the tendency to the grosser forms of embolic infection is not very pronounced. The thrombi being mostly lateral, the blood current is

continuously washing over their surface, and in proportion as their breaking down and softening progresses, minute particles of septic material are carried off and into the branches of the portal vein, and either are arrested in or pass through the capillaries in which those branches terminate. Here, too, mechanical pressure may cause detachment of large emboli.

Embolism. Larger emboli are generally arrested in the main branches of the portal vein, while, according to their size, the smaller ones will enter into the finer ramifications, the smallest detritus being stopped just this side of or in the capillary netting of the liver. Ichor of a very liquid kind will be best adapted to pass through this capillary barrier directly into the vena cava and systemic circulation.

Large emboli may pass directly through the substance of the liver by the way of the large venous anastomoses existing, according to Claude Bernard, between the portal vein and the vena cava.[1]

All these various occurrences may take place either singly and in succession, or may, and actually do, happen simultaneously in combination with each other.

If we consider the effects of each of these forms of transportation or invasion, we find that each calls forth phenomena characteristic of and due to the physical peculiarities of the transported material. It is very rare, however, that these causative conditions should not be complex; that is, that the detached material should be of uniform consistency and size; and hence the resulting phenomena must necessarily also present a mixed or combined character.

Very liquid and almost limpid ichor will, on account of its diffusibility, naturally be most apt to be displaced and be propelled on and, unimpeded even by the capillary system of the liver, readily enter the vena cava and the systemic circulation. The effects produced will depend, first, on the quantity of the septic material thus introduced into the systemic circulation, and, secondly, on its virulence. If the quantity is large and the virulence great, the most intense forms of *intoxication* (to be well distinguished from

[1] Oppenheim. Lungenembolien nach Appendicitisoperationen. Berl. klin. Wochen., 1902, No. 5.

infection) will result—that is, the toxins may, within a few hours, fatally poison the organism—long before there is a chance for any further proliferation of the infectious bacteria contained in the injected ichor. In these cases no bacteria can be found in the blood.

It was and still is customary to attribute the end of a patient dying of heart failure shortly after an unbloody and not exhausting abdominal operation to *surgical shock*, especially if the fatal prostration be not induced by an intense pyrexia. To the author this explanation always appeared to be inadequate, improbable, and contrary to known facts. The absence of a great traumatism and the insignificant loss of blood alone would negative the admissibility of shock. A more plausible solution of the puzzling problem, especially in cases of chronic (interval) appendicitis, will be found in the assumption of septic thrombosis and of the sudden introduction of an adequate quantity of ichor into the circulation to produce fatal toxæmia. The following history seems to offer a fair illustration of the subject:

Case I. (*Mt. Sinai Hospital Records*, 1899, vol. iv. page 22).—Becky C., aged nineteen years, admitted June 27th. Five weeks before admission she had an attack of sharp pain in the right iliac fossa with vomiting, which, however, subsided after a few days. She stated also that for six months she had had a continuous sensation of pain in the belly.

June 23d. Return of severe pain in right iliac fossa with vomiting; bowels constipated. On admission the general condition was found to be good: internal organs normal, abdomen soft and relaxed. In the appendicular region no tumor was found, but there was exquisite tenderness on pressure at McBurney's point. Pulse 76 to 92; temperature 98° to 100.6° F.; urine normal.

30th. Operation under chloroform. The appendix, slightly congested, was found to be bound down by a few soft adhesions, from which it was easily liberated. The adjoining peritoneum appeared pale and glossy. Ligature and ablation of mesenteriolum and appendix, followed by thorough searing by Pacquelin cautery of the stumps; complete closure of abdomen.

July 1st. Vomited dark fluid five times; marked prostration; pulse weak, 130; temperature gradually rising to 101.4° F. Urine contained traces of albumin; quantity forty-three ounces. Absence of abdominal tenderness, rigidity, or distention. An enema brought no stool.

2d. Vomiting more frequent, slightly tinged with blood; pulse wretched, 120 to 150 per minute; temperature 99° to 101.4° F.; urine, forty-two ounces. Local condition of abdomen unchanged, but prostration more marked.

3d. Vomiting continued; pulse 174, scarcely perceptible; patient comatose and collapsed. Temperature rose to 105.2° F. just before death. No post-mortem examination was permitted.

The deep prostration, the feeble and rapid pulse, the cerebral intoxication, the moderate fever all testify to an intense toxæmia, while there is no factor present to justify the assumption of shock in any form whatever. In the etiology we find the history of a prolonged, though not very intense, inflammation of the appendix, which, examined directly after the operation, exhibited a slight thickening and congestion of all its coats, notably of the mucosa, but no ulceration or any destructive process. Unfortunately no microscopic examination of the specimen was made. The presence of a deliquescent old thrombus, its displacement, and the passage of its elements into the circulation afford the most natural explanation of the catastrophe.

If the quantity and virulence of this ichorous material be not too great, the immediate toxic effects exerted upon the circulation and the central nervous system may be overcome by the natural economy of the body. Thus a chance will arise for the proliferation of the septic micro-organisms, resulting in the production of a typical case of acute and frequently fatal septicæmia. In these cases, as a rule, the blood is swarming with cocci.

The slow but more or less continuous washing off of deliquescent or liquid material by the blood current from the surfaces of lateral thrombi in continued thrombosis of the portal vein will also produce more or less intense forms of septicæmia.

The coarser material arrested in the ramifications of the portal vein will establish fixed microbial colonies in the liver, each colony surrounded by a zone of secondary thrombi and necrosis, the final result of which process is the establishment of more or less numerous liver abscesses. This form of invasion is characterized, especially in its beginning, by the symptoms of *pyæmia;* that is, by great oscillations of the body temperature accompanied by profuse sweats. As the fatal end of the process approaches, the pyæmic oscillations of the temperature become less typical and the febrile phenomena assume the character of a remittent septic fever: septicopyæmia.

Symptoms and Diagnosis. Chills accompanied by a rapid rise of the temperature, observed during the course of an appendicitis, however mild as to its local symptoms, may and usually do signify the entrance of septic material into the portal and general circulation. They must be looked upon as a sign of the gravest import. As slight a disorder as is considered to be a chronic obliterating appendicitis may result in fatal pylephlebitis, as shown by the findings of an autopsy published by Ralph Thompson.[1]

Should the seizure pass into a continuous fever, with dry tongue and skin, retching, a clouded sensorium, with a rapidly rising pulse of deteriorating volume and quality, the body temperature remaining above 103° F. with a tendency of mounting as high as 106° or higher, the diagnosis of acute septicæmia will be justified. This development may occur early or late in the course of the disease, and may be present with or without the presence and evidences of local peritonitis. Where the necrosed appendix is enveloped in old and firm adhesions and is entirely walled off from the free peritoneal cavity, the surfaces of which appear to be normal, this course of events is just as often observed as where the surgeon finds a local, more or less extensive peritonitis. Removal of the diseased appendix, evacuation and drainage of the existing abscess, or tamponade and drainage of the infected and inflamed peritoneal surface, one or all, either do not have the slightest influence upon the progress of the malady, or will cause a temporary subsidence of the symptoms only.

[1] Boston City Hospital Reports, 1902, p. 143.

This intractability is due to the fact that septic phlebitis having led to thrombosis, septic material derived from a broken-down thrombus was carried into the general circulation. The morbid process thus generalized has passed beyond the line, where measures undertaken against the primary focus could exert a curative influence.

Cases of this rapidly progressive and usually fatal form of acute septicæmia have been and are seen by every busy surgeon. They are readily understood where we have to deal with extensively gangrenous processes or with pronounced instances of abscess formation. The writer's first experience with this dreadful malady was made in 1895.

Case II. Miss Hannah A., aged twenty-six years, was admitted to Mt. Sinai Hospital August 17th, where she had been sent by Dr. Manges from Brighton Beach. A large abscess occupied the right iliac fossa. She had been ill eleven days. The trouble had commenced with a good deal of local pain, with vomiting and fever during the first four or five days. Then the symptoms became less pronounced and a painful swelling developed in the right iliac fossa, showing deep fluctuation. There was still moderate fever (temperature 101° F.) evenings, but otherwise the patient felt pretty well, excepting as to pain caused by the abscess. Bowels had moved regularly, the belly was soft and flat, and the patient consumed and retained a considerable amount of liquid and semi-liquid nourishment. An incision of the abscess was decided upon and was done the evening of August 17th. The abdominal parietes were divided layer by layer under the guidance of the eye, and the abscess was readily opened and emptied without any disturbance of existing firm adhesions which had walled it off from the free peritoneal cavity. The cavity was not flushed, but two stout drainage tubes were placed in it. Fifteen minutes after the finishing of the operation a severe and prolonged chill set in, the temperature rising to 103° F.

August 18th. The fever continued, the tongue became dry, the belly remained soft and flat, was not painful to touch, and the

bowels moved freely after an enema. The patient had flushed cheeks, was unusually talkative and hilarious, and assured us that she felt perfectly well, but, if let alone, would lapse into somnolence.

19*th*. Temperature rose to 105° F. and never descended below this figure until the end.

20*th*. Patient comatose and cyanosed; temperature 106.5° F.; pulse thready, 160; vomited the first time; belly soft; involuntary evacuations from the bladder and rectum.

21*st*. Evidences of septic nephritis and bronchitis.

22*d*. Died in deep coma with a temperature of 107° F. No post-mortem examination could be had.

As said before, cases of acute fatal septicæmia like this one, originating from a large appendicular abscess, are readily understood, their explanation being obvious.

But when the surgeon sees an exactly similar course taken by a case in which the local changes in and about the appendix seem trifling; where there is no gangrene, no traceable abscess; where the removal of the appendix is undertaken during the so-called "interval," to which the patient had given consent under the assurance of very small risk; where, finally, the simple and easy operation had been done under the scrupulous observance of the usual precautions by a skilful and conscientious surgeon; in short, when, in the presence of all these conditions, the patient succumbs to an acute toxæmia or septicæmia, the case is shocking and grievous indeed.

It has been customary erroneously to attribute such disasters to the importation into the peritoneal cavity of septic material by the surgeon's hands. Without denying the possibility of the fact, we shall endeavor to demonstrate that such an occurrence producing a rapidly fatal septicæmia without the previous development of peritonitis, must be exceedingly rare.

To explain these puzzling cases recourse was taken by many practitioners to the idea of a so-called peritoneal sepsis. Wegner,[1] Grawitz,[2] and, more recently, A. Fraenkel,[3] have experimentally

[1] Langenbeck's Archiv, Bd. xx.

[2] Charité-Annalen, xi. Jahrg.

[3] Wiener klin. Wochenschrift, 1891, Nos. 13 and 15.

produced fatal septicæmia by injecting into the normal peritoneal cavity of rabbits a certain quantity of liquid septic material. It will well repay the trouble to summarize in a few sentences the findings of Fraenkel, who, repeating the experiments of Wegner and Grawitz, has rectified their conclusions in several important points.

On the injection into the peritoneal cavity of rabbits of an emulsion of septic material of known bacterial character and of an ascertained high virulence, the following facts were observed:

1. Certain animals became very sick, but in a few days recovered their health completely.

2. A certain number of the animals died of acute *toxæmia* in less than twenty-four hours. No visible changes were found in the peritoneum at the site of the injection. Smears gained from the surface of the peritoneum yielded no microbes either under the microscope or by culture, nor could any be found by these means in the blood.

3. If the animal did not at once succumb or recover its normal health, the physical signs of true *infection* set in. Within twenty-four to thirty-six hours after the injection reddening of the peritoneum, an exudate, and fibrinous deposits began to appear, and microbes were invariably found on and in the affected peritoneum as well as in the blood. The animals died within three to four days of acute purulent peritonitis.

4. Some of the animals survived for two or three weeks, all dying of multiple sacculated intraperitoneal abscesses.

Let us now examine whether bedside observation yields or not a parallel to the experimental facts just enumerated. The answer may be unhesitatingly affirmative as to headings Nos. 1, 3, and 4, and very reserved, if not positively negative, as to heading No. 2. Under the three headings grouped together above we readily identify conditions ordinarily met with and well known, as either the consequences of peritoneal infection due to ulcerative or traumatic perforation of a hollow viscus, or to accidental operative contamination. The complex of facts described under heading No. 2 corresponds to what has been dubbed "peritoneal sepsis."

Does a laparotomy, performed in a well-equipped hospital, by an experienced surgeon under modern canons, ever present conditions equivalent to the experimental introduction of large quantities of liquid and intensely septic matter into the peritoneal cavity?

In Fraenkel's experiments on rabbits from 1.6 to 5 c.c. of ichor were injected. To produce similar effects in the human body far larger doses would have to be incorporated, doses which would rise to the volume of one or more ounces. The accidental introduction of such quantities of septic material during an operation is simply inconceivable and can never occur.

It may happen, however, that in the course of an operation a septic depot contained in a hollow viscus, a tube, or in the appendix, or in an encapsulated abscess, may be accidentally broken into and soil the normal peritoneum without the knowledge of the surgeon. This accident is fortunately rare, but whenever it has occurred its consequence was simply an extension of the peritonitis over the soiled area. The author himself at least has never observed, nor does he know of a single case recorded in literature, where an accidental soiling of the peritoneum by feces or pus has primarily produced anything else than peritonitis.

By these assertions an absolute negation of the possibility of a natural imitation in the human subject of events as depicted under heading No. 2 is not meant. It is only contended that their occurrence is very improbable and at best must be very rare, so rare, indeed, that it cannot be made use of to explain phenomena of sufficient frequency to be familiar to every busy surgeon.

Setting aside, therefore, both the unproven hypothesis of surgical shock and of peritoneal sepsis, the results of our observations at the bedside, the operating room, and especially at the post-mortem table irresistibly force upon our attention, as causative factors of paramount importance, *septic phlebitis and thrombosis of the roots of the portal vein and embolic processes dependent upon their disintegration.*

This theorem is in full accordance with what we know of septic pylephlebitis, harmonizes with our knowledge of all the aspects of septic peritonitis. There is nothing fanciful or forced in it; on the

contrary, it is capable of solving in a conclusive manner all doubts, dispelling the thickest of the darkness that has enveloped this important subject. The word "theorem" is used here advisedly, because, to bring the matter to actual proof, *positive demonstration* of certain facts is necessary.

Such a demonstration is attainable by the labor of the pathologist. The post-mortem table has yielded to us all the links of the chain that connects an inflammatory condition of a mesenteric vein with septic pylephlebitis and with embolic purulent hepatitis. It has put beyond any doubt the occurrence in appendicitis of fatal toxæmia, and has demonstrated that the door through which it enters is the portal vein. All that remains to be done is the visual demonstration of the existence of phlebitis and of septic thrombi in the appendicular region in such cases, where directly after the performance of a simple and easy aseptic "interval" operation the patient succumbs to an irresistible septicæmia, though no demonstrable operative infection of the peritoneum be present before or after the operation.

Note.—It is significant that almost all of these mysterious cases of postoperative septicæmia occur after "interval" operations for appendicitis; that is, where repeated attacks of a local sepsis have preceded and presumably have left behind deposits of an equivocal character.

To the author's knowledge this work is as yet undone. It would involve a much more minute and exact examination of the roots of the portal system than pathologists are wont to make. To clinch the matter it must be demonstrated in a given case: 1. That septic phlebitis and thrombosis due to appendicitis were present. 2. That no peritonitis exists. 3. The absence of septic conditions originating in any region not drained by the portal system must be shown.

Proof of these facts will do two good things. It will shed much needed light upon a dark subject, and it will remove undeserved blame from the operator, who has the misfortune to encounter a patient with a septic thrombus, which is ready to be detached and to be carried into the circulation on the slightest provocation.

We may now pass on to the consideration of the later stages of portal phlebitis. The subject is trite, all its aspects are well studied, and it will suffice to give Bryant's[1] excellent summary of the salient symptoms of the disorder: "Pyrexia, rigors, sweating, rapid pulse, abdominal pain, and tenderness in the right hypochondriac or the epigastric region, together with uniform enlargement of the liver and tenderness of that organ, especially if associated with or following any ulcerative lesion of the alimentary tract below the œsophagus, should suggest the possibility of suppurative pylephlebitis."

The gist of the matter as to the diagnosis lies in these three propositions:

1. The presence or precedence of an infectious process involving the abdominal contents.

2. The presence of pyæmia.

3. The implication of the liver.

The diagnosis, made the first time in the living subject by Schoenlein, is not difficult when the initial affection is known, and especially when, as Fred Taylor[2] justly remarks, *the diagnostician is familiar with the disease.* Otherwise, it may be very difficult indeed.

Bryant names the following diseases that have been confounded with suppurative pylephlebitis: pyæmia, septicæmia (from extraportal causes), typhoid fever, malaria, adhesive pylephlebitis, catarrhal and other forms of jaundice, chronic catarrh of bile ducts, biliary calculus, cirrhosis of the liver; Chvostek[3] gives the following: catarrhal pneumonia, general septic pneumonia, empyema, subdiaphragmatic abscess, spinal caries, and rupture of a reduced hernia. Taylor adds malignant endocarditis.

To avoid error the following points may be found useful:

1. Demonstrate that the existing pyæmia or septicæmia is not caused by any lesion within the pale of the systemic circulation,

[1] I. H. Bryant. Guy's Hospital Reports, 1900, vol. liv. p. 88.

[2] A Case of Suppurative Pylephlebitis. Guy's Hospital Reports, 1902, vol. lvi. pp 109–126.

[3] Krankheiten der Pfortäder. Wiener Klinik, March, 1882, Heft 3.

and *especially not by malignant endocarditis*, a task which is very hard, when not even a murmur is demonstrable to indicate the presence of this treacherous malady.

NOTE.—A small but important lesion pertaining to the area of the general circulation may be easily overlooked.

2. Do not forget that the violent oscillations in the temperature (from 105° to 96° F.), which are so characteristic of the initial stages, become less and less typical as the disorder progresses. In protracted cases the fever is of a constant and remittent type, the chills disappear (Chvostek and Gerster), and the oscillations are merely accentuated by profuse sweats.

3. Again and again search for the primary septic focus in the belly.

4. Remember that the evidences of hepatic trouble are often very equivocal. Though the liver is mostly somewhat enlarged, local pressure pain and jaundice are often absent. The enlarged spleen is not distinctive, nor do the stools offer anything characteristic.

5. A persistent local pressure pain along the right rectus abdominis, extending upward toward the epigastrium and accompanied by fever, observed after an appendicitis operation, and where the abdominal wound is healing or healed, justifies a strong suspicion of continued pylephlebitis if there are no signs of sacculated peritonitic abscesses. (See Case IX., Mrs. L.)

PROGNOSIS. The prognosis is very bad, but not invariably hopeless. Chvostek[1] published the history of a case where a hepatic abscess was incised and drained by him, resulting in the cure of the patient. Emmanuel Herczel,[2] of Budapest, also reports a similar case. Probably these abscesses were solitary and the virulence of the infection could not have been very great. Ralph Thompson[3] mentions recoveries reported by Loison, Sheen, and Munroe.[4] Under favorable circumstances, even a spontaneous

[1] Loc. cit.

[2] Epityphlitis és annak sebészi Kezelése. Budapest, 1900.

[3] Loc. cit.

[4] Lymphatic and Portal Infection following Appendicitis. Boston Med. and Surg. Journal, January 23, 1902.

cure may ensue. The autopsy of Case IX. seems to afford sufficient grounds for this assumption.

Therapy. It seems clear that, as regards purulent pylephlebitis caused by appendicitis, an early diagnosis of the primary trouble and prompt operation offer the only reliable safeguard.

The occurrence of a chill is of the gravest import and should be considered to constitute a more urgent indication to operate than even the signs of local peritonitis. Where much necrosis is found it would be very desirable to expose and evacuate thrombosed veins.[1] On account of their anatomical relations this is sometimes easy, oftener difficult, and mostly impossible. During the operation unnecessary pressure by retractors, sponges, or the fingers of the surgeon should be carefully avoided. Hence, an incision of adequate length is necessary and the puerile attempts at removing a diseased appendix through a mere buttonhole are to be condemned.

The evacuation of septic thrombi from the jugular vein in mastoid disease has yielded such excellent results, that the application of the principle to the portal vein would be natural and logical. But the anatomical relations, while very favorable in the former instance, are just the reverse in the latter. Only a short piece of the portal vein, that situated in the hepatoduodenal ligament, is approachable. The two mesenteric veins and the splenic are practically inaccessible. Hence, though phlebotomy of the portal trunk in the hepatoduodenal ligament is not impossible, the evacuation of thrombi by flushing through a catheter seems to be too problematic, not to mention the technical difficulties the surgeon might encounter in the closure of the phlebotomy wound. The usual multiplicity of the abscesses found in the liver renders the incision and drainage of one or a few of them absolutely worthless. Chvostek's and Herczel's successes may be justly called exceptional.

In fulminant toxæmia copious infusions of saline solution would seem to deserve trial, likewise in cases of septicæmia. In one of the author's cases the employment of Marmorek's antistreptococcic serum proved of no avail; but it is proper to state that it was

[1] See histories of Cases XIII. and XIV.

resorted to too late, that is, at a time when the liver was honeycombed with abscesses.

We may say, then, that the treatment will have to be simply a symptomatic one.

The histories upon which was based this study and which were not communicated in the text, follow here:

(*a*) *Acute Toxæmia and Septicæmia.*

Case I. was given on page 43.

Case II. was given on page 46.

Case III. (*Mt. Sinai Hospital Reports*, 1901, page 284; 1900, vol. ii. page 94).—*Acute perforative gangrenous appendicitis; large localized abscess; evacuation of abscess; removal of appendix; drainage; acute toxic resorption; death third day following operation.* Abraham S., aged fourteen years, a school-boy, was admitted in the afternoon of August 13, 1900. The present attack was the first one, and was of eight days' standing. Had one chill, followed by fever, the day before admission. A large tumor could be felt in the right iliac fossa, very painful and tender, and bulging into the rectum; immediate cœliotomy. No free fluid was present in the peritoneal cavity. A large abscess cavity occupied the iliac fossa; when it was opened there followed a gush of fetid pus. The appendix, perforated and gangrenous at the tip, lay in this abscess cavity. It was shelled out of its peritoneal coat and ablated. The cavity was thoroughly evacuated and drained by tube and gauze. The temperature declined to 99° F. immediately after operation, but in the evening it rose to 102.6° F. The following day the temperature rose to 103.2° F., the pulse rate to 110. The discharge from the abscess cavity was profuse. The abdomen was soft and lax. The bowels moved freely and there was no vomiting.

August 15th. The temperature and pulse were still high, 103.6° and 136° F., respectively. The urine contained a large amount of albumin and no casts. Icterus developed and the sensorium was clouded and delirious.

16th. During the night of August 15th the temperature continued rising to 104°, 105°, and finally reached 108° F. in the even-

ing of the 16th. The abdomen continued to be soft, not tender; the bowels moved; there was no vomiting; the wound looked well; the icterus was more marked. The high temperatures and the pulse rate and the delirious condition were the only symptoms until death occurred, on August 16th.

No post-mortem permitted.

(*b*) *Suppurative Pylephlebitis.*

Case IV. (1894, vol. ii.) *Perityphlitic abscess; pylephlebitis; incision; drainage; death.*—Ida M., four months ago gave birth to a child; was apparently well until three weeks ago, when she began to suffer from general abdominal pain, chills, and fever. Pain was not localized. Subjective history was very unsatisfactory; temperature 105.4° F.; respiration 44; pulse 120. On admission, May 16, 1894, her general condition was poor; patient pale, anæmic, and icteric; tongue dry and coated; pulse rapid and weak; lungs and heart negative; abdomen slightly distended; liver two fingers below free border of fourth rib; marked tenderness over the liver; spleen enlarged, palpable; vaginal examination negative.

May 16th. Bowels moved effectually by enemata.

17th. Temperature 101.6° F.; respiration 28 to 40; pulse 108 to 130; had severe chill. Operation under chloroform. Under anæsthesia mass palpable in right inguinal region. Incision over mass. Tumor was found to be behind and outside of the peritoneum. Aspiration yielded foul pus. Tumor incised, pus evacuated from between folds of mesentery; drainage established with iodoform gauze.

18th. Temperature 99° to 105.8° F.; respiration 40 to 60; pulse 106 to 150. Patient had several severe chills; rise of temperature after each chill; is delirious at times; pulse irregular and intermittent; urine contains granular casts, bile, pus.

19th. Temperature 99° to 108° F.; respiration 48 to 64; pulse 142. Patient failed rapidly; death.

Autopsy through the Wound. Slight jaundice; abdomen contained a moderate amount of turbid serum. Intestine: adhesive peritonitis; ileum constricted by adhesive band, causing obstruc-

tion; appendix swollen, inflamed, and perforated at the tip. In the ascending mesocolon near the appendix was an abscess the size of an egg which had been opened and drained. Spleen enlarged and septic; kidneys negative; liver somewhat enlarged. On the surface of the right lobe were two abscesses the size of a walnut. On section multiple abscesses everywhere. Septic pylephlebitis.

Case V. *Gangrenous appendicitis; secondary suppurative pylephlebitis; abscesses of the liver, pancreas, and omentum; death.*—Keile U., aged forty-two years, Russian housewife, admitted on December 19, 1894, to Mt. Sinai Hospital, gynecological service. She was in this hospital one year ago, operated upon for salpingo-oöphoritis (double). Both ovaries were removed. Was well since that time up to six months ago. For the last six months complained of pain in the lower part of the abdomen. Four weeks ago had chills and fever, headache, and pain in the hypochondriac region. These pains and the fever have continued off and on up to the present; bowels constipated; some leucorrhœa.

December 22d. Transferred to medical side.

23d. Temperature fluctuated between 100.6° and 103° F.

24th. Physical examination: general condition fair; tongue coated; lungs, slight general bronchitis; heart, systolic murmur at apex; liver normal; spleen enlarged to its free border; cicatrix in median line below the umbilicus; tenderness on palpation over the cicatrix; no spots; temperature fluctuated each day between 100° and 104° F.; at times had chills. Had ten grains of quinine in the morning.

26th. Urine: acid, clear, 1018, bile; systolic murmur over pulmonalis.

28th. Liver dulness about three fingers below free border in the mammary line. Tenderness and pleural crepitation from the angle of the scapula to base in axillary line.

31st. Had pericardiac rales over centre of sternum.

January 2d. Temperature subnormal and then rose to 103° F.

3d. General condition same. Temperature varied each day between 99° and 104° F.; at times chills.

4th. Transferred with the diagnosis of liver abscess to surgical

side. A careful examination of the pelvic organs elicited no positive result except the manifestations of pain on pressure, which were pretty general. No tumor could be felt in the right iliac fossa.

5*th*. Aspirated liver and pus withdrawn.

6*th*. Prepared for operation.

7*th*. Operation under chloroform; incision about four inches in length over region of the liver. Peritoneum found free. Liver sutured to peritoneum and abdominal walls with catgut. Wound packed with iodoform gauze and dry dressing applied.

8*th*. Second operation under chloroform. Liver aspirated in several places and at last found pus. Grooved director and dressing forceps introduced and opening dilated. Small quantity of pus evacuated. Drainage tube inserted, irrigated, packed with iodoform gauze, and dry dressing applied. Patient slept greater part of night. Temperature normal.

10*th*. Patient's general condition poor. Septic look; refused medicine; was stimulated hypodermically.

11*th*. General condition became worse and the patient died; temperature before death was 106.6° F.

Autopsy. Liver: right lobe adherent, not enlarged; soft and septic; on section lobules not apparently congested; multiple abscesses from pea to walnut-size, containing thick green pus. Portal vein contained pus; cellular tissue around portal vein indurated and full of abscesses. Pancreas: multiple abscesses. Omentum: veins filled with pus. Intestines: appendix gangrenous and perforated; a very small abscess behind the cæcum. Spleen enlarged, soft, and septic. Kidneys enlarged, capsules not adherent; cortex pale.

Case VI. *Gangrenous appendicitis and pylephlebitis; incision and drainage of appendicular abscess; transpleural hepatotomy; death.*—Joseph R., aged twenty-nine years, admitted to Mt. Sinai Hospital's surgical service October 27, 1899, from the medical side. History began three weeks ago with a chill, followed by fever and sweating. Such an attack was repeated daily, and then every other day; general malaise; slight conjunctival icterus. Examination: spleen enlarged to percussion, but not felt. Liver extends from

sixth rib to free border; lungs and heart negative; temperature 101° to 103.4° F.; marked leucocytosis; no plasmodia.

October 21st. Temperature 99° to 105.2° F.; chill.

22d. Temperature 102.6° to 105.8° F. Sausage-shaped mass in appendicular region, which was not very tender or painful. Rectal examination negative.

24th. Daily temperatures between 101° and 103° F.; at times a chill. Mass in appendicular region persists, likewise the fever. Urine separated by Dr. Harris with segregator. Examination showed casts and albumin in both specimens. Examined by Dr. Gerster under anæsthesia. Aspirated in right lumbar region; pus withdrawn. Pus was offensive and greenish in color; temperature 98° to 105.4° F. Was transferred to surgical service.

27th. Operation; posterior incision for retroperitoneal abscess and about half an ounce of foul pus evacuated from iliac fossa.

28th. Chill; temperature 104.2° F.

29th. Foul purulent discharge from wound; violent chill; temperature 105.2° F. Daily chills and temperature rising at times to 107° F.; marked leucocytosis.

November 14th. Tenderness over the liver, especially in the axillary line. Dulness over the liver in this line extending higher than normal. Transpleural hepatotomy for liver abscess by Dr. Brewer (adjunct). Multiple abscesses found and drained; died a few hours later.

Autopsy of Abdominal Contents. Liver enlarged, soft; large number of abscesses in the right lobe. In the trunk of the portal vein is a purulent thrombus; the walls of the vein are necrotic and in places eroded into an adjoining abscess cavity. Appendix: retrocolic situs; tip absent. In its place is found fibrous tissue representing the abscess which had been drained by the first operation.

Case VII. (*Mt. Sinai Hospital Reports*, 1901, p. 279). *Fulminant gangrenous appendicitis with simultaneous thrombosis of the veins of the mesenteriolum; removal of a totally gangrenous non-perforated appendix twenty-four hours after the first onset of the malady; purulent phlebitis of portal vein; multiple abscesses and partial mass necrosis of liver; death from septicopyæmia nine-*

teen days after operation.— E. O. L., aged forty-eight years, banker, a man of large stature, somewhat obese and of a florid habit heretofore, with the exception of a severe pneumonia passed through several years ago; in perfect health; had attended to his business up to noon of April 12th, when he lacked appetite at luncheon and began to feel some pain in the abdomen. This was not severe enough for him to cancel a dinner party at his own house. Among the company was his family physician, who noticed that his host was rather pale and abstemious, but kept his seat at table until his company dispersed, late in the evening.

The doctor, remaining behind, was told that the patient felt an atrocious pain in the iliac fossa. His pulse was then between 80 and 90, the temperature normal. A hypodermic injection of morphine stilled the pain. The next morning the patient reported having spent a wretched, sleepless night. Shortly after midnight a severe chill had set in, lasting an hour and fifteen minutes, ending with profuse sweat. At 8 A.M. the patient vomited. At 9 A.M. the doctor found the temperature above 104° F., the pulse 90, the pain in the iliac fossa still excessive. At 9.45 A.M. he was seen by Dr. Gerster. The abdominal wall was very rigid over the site of the appendix, elsewhere soft, and pressure over McBurney's point was exquisitely painful. Rectal examination revealed nothing unusual. The temperature was falling and by noon reached 102° F. and a fraction. A slight icteric tinge was noticed in the sclerotic.

The case was declared to be a very grave one, needing speedy action, and the patient was transferred to the hospital, where the operation was performed at 1 P.M.; that is, just twenty-four hours after the first manifestation of the trouble and twelve hours after the first rigor.

The patient's internal organs, kidneys included, yielded no morbid signs.

After opening the abdominal cavity a small quantity of turbid serum escaped. Readily the dusky, almost slate-colored appendix was brought to view, its situation being rather superficial. It was nowhere confined by adhesions. Its surface appeared mottled by yellowish spots and roughened by adhering shreds of fibrin. Its

distended and erect condition and elastic, hard feel demonstrated that it was filled, almost unto bursting, with liquid matter, and nice handling was required to remove it whole and unbroken. Evidently its rupture was imminent and would have been followed by the most virulent septic peritonitis. While liberating it from its mesenteriolum it was noticed that the latter was excessively brittle, permitting the ligature to cut through it immediately. And as blood flowed neither from vein nor artery, it was concluded that these vessels must be occluded—in short, that we had to deal with a mesenteric thrombosis, probably of a septic character.

The appendix was ablated close to the cæcum, was in its entirety gangrenous and filled with horribly fetid, greenish-gray ichor. While distended and *in situ* its diameter was fully three-quarters of an inch. The removed portion measured four and one-half inches.

A gauze-wick drain was placed against the appendicular stump and was brought out to the surface. Except where this wick emerged the wound was closed in the usual manner. The patient, a cool, cheerful, and resolute man, bore the operation excellently, and in the course of the next twenty-four hours his temperature and pulse were restored to the normal standard, the former being 76 to 84, the latter 98.6° F. The peritoneal symptoms had vanished, and on the surface affairs looked promising, but apprehensions were not lulled by these appearances of peace.

April 14th. Calomel and salts were given and produced a number of liquid stools. The temperature rose to 102° F., but the patient felt well and consumed and retained large quantities of liquid nourishment. During the night a slight chill occurred.

15th. A thorough examination of the wound was made, the wick drain was removed, and was followed by a few drops of fetid serum. The belly was soft and painless, the patient expelling gases freely, and retained much liquid nourishment. Examination of the lungs showed signs of congestion corresponding to both bases; but there being no pain and no dyspnœa, it was concluded that the dull percussion sound and sharp breathing were caused by hypostatic changes—a most ominous sign. From this on the physical appearances of the lungs remained stationary to the end. The icteric hue

of the sclerotics also became more noticeable. In the evening the patient vomited a large quantity of water, the melted product of much ice he had chewed and swallowed.

16*th*. The temperature rose to 103.4° F., with a marked chill. The wound was irrigated and dressed three times daily, discharging less and less of serum, on which floated a few drops of fat and a few shreds of necrosed tissue, evidently cast-off portions of the mesenteriolum. The belly remained soft, the bowels moving daily. The liver and spleen slightly intumescent, the former not painful to forcible pressure and manipulation.

17*th*. Local conditions unchanged. The urine showed no diminution of chlorides; icterus more pronounced. Urine, barring the presence of bile pigment, normal. In the afternoon had a long and severe chill, the temperature rising to 105.4° F. Splenic tumor more pronounced.

From this on there were daily several more or less hard chills, followed by profuse sweating. With the chills the temperature rose to 105° and 106° F.; after profuse sweating it dropped to nearly the normal standard.

20*th*. During the day three hypodermic injections of fifteen grains each of the hydrochlorate of quinine and urea were given without appreciable effect, except causing slight deafness. A blood culture yielded an absolutely negative result; no plasmodia.

Though it was evident that we were dealing with a pyæmic form of virulent sepsis, our efforts were not relaxed. From this date on altogether eight injections of Marmorek's antistreptococcic serum, each dose consisting of 8 c.c., were made and very well borne, but they did not alter the course of the malady.

21*st*. Albumin was found in the urine, together with renal epithelium, a few granular casts, and pus cells. The wound discharged scantily a colorless and odorless serum. The swelling of liver and spleen had markedly increased, but there was no pressure pain. Severe chill, with a temperature of 106.6° F., also the appearance of a rash was noted.

And so it went on to the end. Chill after chill followed, the sensorium remaining perfectly unclouded to the very end. The

belly remained soft, bowels active; food was well retained, except the last two days.

25*th.* The patient began to complain of pain in the epigastric and hepatic regions, which was augmented by pressure. He was now deeply jaundiced and there was no doubt that we had to deal with abscesses in the liver. The urine became more and more scanty, the pulse softer.

28*th.* The stomach rejected all ingesta, but there was no vomiting if the patient abstained.

29*th.* A marked collapse following one of the usual severe chills, but the patient rallied. Pulse remained remittent.

May 1*st.* Out of full consciousness the patient fell back and died of heart failure.

Autopsy, May 2, 1900. Eighteen and one-half hours post-mortem: marked rigor; marked general icterus.

Wound. Incision (wound) 12 cm. long in right iliac region, covered with healthy granulations leading to a sinus which leads down and in, containing some cloudy fluid; intestines adherent to the lower angle of the wound. Sinus, where the walls are covered with dark-colored fibrin, leads to appendicular stump, which is covered with fibrin. Intestinal coils adherent to each other near the stump of the appendix.

Spleen. Enormously enlarged, flabby, congested; section shows diffluent pulp; numerous small hemorrhages; 19 x 14 cm.

Kidneys. Left, enlarged and succulent; section shows congestion and marked degeneration; capsule somewhat adherent. Right, same; more flabby. Both kidneys and capsules are bile-stained.

Liver. Very much enlarged and congested; parenchymatous degeneration. In the portal vein there is a parietal thrombus covered with a layer of pus. Along its branches are a large number of abscesses varying in size from miliary to those of 2 cm. in diameter. In the dome of the right lobe there is an enormous number of closely packed abscesses, between which the liver parenchyma is necrotic. Veins in the mesentery near the appendix not thrombosed.

Heart. Right auricle markedly distended with post-mortem

clots; valves bile-stained; free edge of tricuspid thickened; right ventricle moderately dilated; muscle pale. Free edge of pulmonic slightly thickened. Left auricle markedly dilated; ventricle slightly hypertrophied; no dilatation; mitral slightly thickened; endocardium between mitral and aortic valves thickened; aortic valves slightly thickened; moderate atheroma of aorta and coronaries; muscle cloudy.

Lungs. Left: at apex, slight adhesions; emphysema of upper lobe; fibroid patch at apex; marked congestion and œdema, especially at base; bronchial glands moderately enlarged and anthracotic. Right: at apex, fairly firm adhesions; very small calcareous nodule at apex; very marked œdema and congestion, especially of the lower lobe; glands the same.

Pancreas. Congested and degenerated. In the mesentery are two calcareous areas 1 cm. in diameter (healed tuberculosis?).

Microscopically. Pancreas, focal necrosis; kidney, congestion, hemorrhages, marked acute degeneration, marked inflammation.

Spreads. Spleen: very few cocci; liver: numerous streptococci.

Cultures. Right heart, coli; left heart, coli; abscess in liver, coli and streptococci; spleen, coli.

Diagnosis. Appendectomy; purulent inflammation of portal vein (?); multiple abscesses of liver (streptococcus); acute hemorrhagic inflammation of spleen; chronic nephritis; acute hemorrhagic nephritis; acute degeneration of liver; hypertrophy of left ventricle; parenchymatous myocarditis; moderate atheroma of aorta; congestion and œdema of lungs; focal necrosis in pancreas.

Case VIII. (*Mt. Sinai Hospital Reports*, 1901, p. 283). *Acute gangrenous non-perforative appendicitis, with thrombosis of the vessels of the mesenteriolum; appendectomy seventy-two hours after onset of the attack; death from pyelophlebitis and septico-pyæmia seventeen days after operation.*—Milton S., aged nineteen years, a clerk, has had several previous mild attacks of appendicitis. Three days before his admission to the hospital on October 11, 1900, he commenced to have severe pain in the right iliac fossa. Forty-eight hours later he had a chill, followed by high fever. On admission the abdomen was not distended, the right rectus muscle

was rigid, and there was marked tenderness in the right iliac fossa. No tumor could be felt; his temperature was 102.8° F.; pulse 116; urine normal. Immediate operation was proceeded with. The right iliac fossa was exposed by the usual incision through the rectus sheath. The appendix was at once found, lying quite superficially on the anterolateral aspect of the ascending colon, surrounded by adherent omentum. The appendix was rigid and erect and the bloodvessels of its mesenteriolum thrombosed. The appendix was about two and one-half inches long, non-perforated, obliterated at its apex, and its mucosa necrotic. The lumen was filled with ichorous pus. The mesenteriolum was secured with a stout catgut ligature, the appendix ligated at its base, and ablated. The wound was closed by sutures, drainage being placed to the bed of the appendix.

Immediately after operation the temperature rose to 105.2° F., the pulse rate to 148. Vomiting occurred after the administration of divided doses of calomel. The temperature receded toward evening. The next day (October 12th) the temperature again rose to 103.4° F., the pulse to 144; vomiting was repeated. The abdomen was soft, not tender, and the bowels moved freely. Toward evening singultus bothered the patient considerably.

October 13th and *14th* the condition remained the same.

15th. The patient became delirious at times. The temperature and pulse elevations were not so high; on the other hand, icterus developed and the urine contained a few hyaline casts.

16th. There was some tenderness over the liver; the abdomen was soft; the bowels moved daily, and nourishment was taken and retained. Singultus continued to trouble the patient very much. From day to day the patient's general condition became gradually worse; the temperature daily rose to 102° and 103° F., the pulse rate proportionately; but the character of the pulse was growing gradually worse. The wound healed *per primam.* The abdomen remained soft; the icteric condition fluctuated in its degree of intensity; the cerebral condition was always clouded; at times delirious. The urine contained albumin and hyaline casts. The tenderness over the liver was not marked.

22*d*. A blood culture was negative. The patient gradually grew weaker and weaker, and succumbed from exhaustion on October 28, 1900. Post-mortem examination was not permitted.

CASE IX. *Gangrenous appendicitis; suppurative pylephlebitis; operation; pyæmia; death.*—Minnie L., aged forty-five years, housewife, had an attack of appendicitis four years ago, and again two years ago, and again four months ago. Present history began three days ago with chill and sharp pain in right iliac fossa. Pain has persisted and grown worse; has been vomiting since first day; had a second chill yesterday and another one early this morning; bowels had moved yesterday; had some fever.

On admission, April 22, 1901, the following was noted: general condition fair; tongue dry and coated; lungs, heart, spleen, and liver negative; abdomen distended and tympanitic. In the right iliac fossa marked tenderness and rigidity; rectal and vaginal examination negative. Immediate operation: Kammerer's incision; appendectomy; appendix markedly congested and swollen; gangrenous throughout; its mesenteriolum gangrenous.

April 23*d*. Had slight chill; temperature 103° F.; urine acid, clear, 1022; no albumin; urates.

24*th*. Felt chilly; temperature 104° F.

25*th*. Packings shortened; purulent discharge from wound.

26*th*. Chill; increased pulse rate from 100 to 160.

27*th*. Pulse still rapid; free stimulation.

28*th*. Slight discharge from wound; general condition improved.

29*th*. Two chills; temperature up to 104° F.

May 5*th*. Two to three chills daily, each lasting three to fifteen minutes; after chills temperature rose to 105° F.; pulse 90 to 150; general condition failing. The wound healed in sutured portion. Through the drainage opening there is still a slight, yellowish-brown, purulent discharge.

11*th*. Chill; temperature rises to 107° and falls to 96.6° F. in eight hours. Complains of considerable abdominal pain, but at palpation no area of tenderness can be located. Slightly hypersen-

sitive over liver; tongue coated with blisters; has been taking large amount of fluid and solid nourishment.

17*th.* A distinct systolic murmur at apex; temperature not above 103° F. for past three days; no chills from May 14th to 25th; temperature during this period fluctuated between 99° and 103.4° F., and her general condition seemed to be fairly good, though the pulse continued to be rapid.

25*th.* Patient irrational at times; complains of some cardiac pain; heart murmur more distinct.

June 1*st.* Temperature not above 101° F. for three days past; no chills from May 25th to time of death. Has distinct tenderness over the liver at its lower border in the mammary line; liver enlarged and easily palpable half an inch above the umbilicus; tongue moist; takes nourishment well.

6*th.* Cardiac murmur louder; wound discharges less; cerebral condition improved.

26*th.* Complains of general abdominal pain; tenderness in left iliac fossa. Splenic dulness merges below with an area of marked flatness, which latter extended downward to the iliac fossa. Spleen enlarged; could be felt separately and distinct from this lower area of flatness. Over the left side distinct pain and tenderness. Marked fluid wave in the abdomen; general condition bad; pulse small, soft, and rapid; temperature between 100° and 104° F.

July 14*th.* No tubercle bacilli in sputum. Patient complains of severe general abdominal pain, which recurs every afternoon. Occasional attacks of cough and dyspnœa; heart action rapid and more feeble; murmur marked; temperature 103° F.

15*th.* Death. Urine never showed any kidney elements.

Autopsy. Large amount of clear and opalescent fluid in the peritoneal cavity; partly sacculated in the flanks. Lungs: large amount of clear fluid, with flakes of fibrin in pleuræ; both lungs congested and œdematous. Heart: slight increase of clear fluid in pericardium; slight chronic thickening of valves (tricuspid, mitral, pulmonary, and aortic); no acute lesion of valves or heart walls. Spleen large, soft, acute and septic; splenic vein negative. Kidney: slight chronic nephritis, with congestion. Adrenals and pancreas

negative. Liver slightly enlarged; substance soft and grayish in color. Branches of the portal vein in the liver show changes the same as described later in the portal vein proper, except that some of the smaller branches appear to be closed by fibrous tissue. Along branches of the portal veins in the liver are some whitish nodules about the size of a pinhead, which appear to be old miliary abscesses. From some of these pus exudes, but not from others. Gall-bladder small and adherent to omentum and transverse colon; contains some firm, faceted stones; wall trabeculated; covered by fibrin in places; rather firmly adherent stone in the cystic duct. In the common duct is a freely movable stone; common duct is somewhat dilated. Intestines adherent to each other with sacculations of the mesentery; clear fluid; white fibrin on coils. Small intestine floats as one mass upward and forward; cæcum and ascending colon partly adherent to the abdominal wall; appendix stump hardly visible. In the pelvis is a large, irregular, abscess cavity containing green pus and bounded by the uterus below and adherent gut and mesentery on the sides and above. It lies in Douglas' cul-de-sac. Into this opens the cavity from the mesentery containing similar pus. It appears to have been due to suppuration of mesenteric veins, as near the edges pus tracts are found emptying into it which prove to be suppurating veins. Suppurating tracts found leading up to the portal vein. Veins near the appendix stump show no macroscopic changes. Portal vein and branches: no pus in lumen nor obstructive thrombus; on the walls are firm, yellowish deposits which appear to be the remains of parietal purulent thromboses. At its lower part the portal vein is rather narrow and the remnants of the thrombus extend around the entire circumference of the vessel. Vena cava inferior and vena hepatica show no changes. Intestines when opened negative, except for slight patchy inflammation of mucosa. Mesenteric nodes moderately enlarged; in the median and left parts of the mesentery but few are seen. Supposed that some were destroyed by the suppuration. Microscopic examination of the liver demonstrates the presence of large numbers of purulent foci, many of which are quite far advanced toward organization. There are also some fibrous areas

around some of the branches of the portal vein which seem to be the result of organization of the purulent foci. The wall of the portal vein shows that the thrombi were in an advanced stage of organization. Smears from the mesenteric abscess show numerous streptococci and many bacilli, some of which decolorize by Gram and others which do not. Cultures show streptococcus and B. coli.

Case X. *Acute gangrenous appendicitis; thrombosis of mesenteriolum; septicæmia; death.*—Eleonora Z., aged eleven and one-half years, admitted to Mt. Sinai Hospital October 13, 1901. Ordinary childhood diseases. Three months ago had an attack of indigestion, with abdominal pain; no fever at that time; no chill. Present history of two days' standing; at onset, pain in abdomen, general at first, later localized in right iliac fossa; vomiting at onset and throughout the two days; fever of 103° F.; chill twenty-four hours after onset; no cough or expectoration. Examination: abdomen lax; in right iliac fossa a tender mass the size of an egg. Rectal examination reveals tenderness and fulness high on right side. Immediate operation; appendix recurved, three inches long; club-shaped, dusky in color; stricture at junction of the proximal and middle third; distal third thickened and congested; its mucosa necrosed and perforated into the mesenteriolum. Appendix was removed; drainage. Diagnosis: gangrenous appendicitis and suspected portal involvement. After the operation the patient's temperature rose to 104.4° F., pulse to 120.

October 14th. Child restless; no signs of peritoneal involvement; face pinched; restlessness increased, and child became apathetic; pulse more rapid; temperature varied between 99° and 105.4° F.

15th. Child in collapse and died.

No full autopsy could be secured, but the abdominal contents were removed through the incision *en masse* for examination. Appendicular stump found firm, surrounded and covered by purulent lymph; no evidences of general peritonitis; no exudate in the pelvis. Leading from the appendicular stump was a thrombosed small vein which led up into the superior mesenteric vein; throughout its whole extent were marked changes. In places the lumen

was closed by purulent material or a dark red thrombus. At other places there was only a parietal purulent thrombus adherent to the wall of the vessel. The wall itself was not particularly affected, except for some evidences of slight inflammation involving small areas. But at irregular intervals small collections of pus were found outside and directly alongside of the vessel. The superior mesenteric vein was filled by a non-adherent, dark, and soft thrombus. The portal vein was not yet involved. Mesenteric nodes were enlarged, some of them dark red. Spleen moderately enlarged and congested, its pulp soft. Liver enlarged; acute degeneration; marked inflammation, with leucocytes. Kidneys: capsules not adherent; congestion; acute nephritis.

Case XI. (from the service of Dr. Howard Lilienthal). *Acute gangrenous appendicitis and abscess of mesenteriolum; suppurative pylephlebitis; appendectomy; exploratory laparotomy for liver abscess; death.*—Robert K., aged twenty-two years; present attack began December 8th with local abdominal pain, vomiting, chills, and fever. On admission December 14, 1901, general condition was good; abdomen rigid; in right iliac fossa tender mass size of a fist; rectal examination negative; temperature 103° F.; pulse 110.

December 14th. Ether anæsthesia; Kammerer's incision; after separation of some omental adhesions appendix appeared three or four times its normal size. Mesenteriolum very much thickened and rigid; while this latter was being tied off in sections an abscess with gangrenous walls opened near the base of the appendix. Appendix tied off and removed; drainage.

18th. A remittent constant fever continued; its cause appeared not to be influenced by the treatment.

22d. Liver dulness much enlarged; liver not tender to pressure. Pressure pain just to right of the umbilicus; right rectus still rigid; leucocytes 24,000.

26th. Liver repeatedly aspirated; from one of the punctures a drop of pus was obtained.

28th. Exploratory laparotomy to afford better facilities for aspiration; through the abdominal opening numerous aspirations were repeatedly made, but with negative results; the temperature con-

tinued to fluctuate between 101° and 104° F.; the chills were repeated.

January 6th. Sudden death during the night after a severe chill.

Autopsy through Wound. Small amount of well walled-off pus about appendix stump; no general peritonitis; no lesion of veins immediately about the appendix stump. Many enlarged suppurating lymph nodes in mesentery; many are fused together; some connected by suppurating tracts. In two places veins found exposed by the suppuration. In these veins purulent thrombi. Portal vein shows parietal purulent thrombosis extending into intrahepatic branches. Multiple liver abscesses. In dome of right lobe large abscess with necrotic walls containing thick, tenacious pus, light brown in color. Enlarged septic spleen; kidneys congested. Spreads: in all abscesses streptococci and a bacillus positive to Gram, not growing in aërobic or anaërobic cultures. Cultures: mesenteric abscess: streptococci, B. coli, staphylococci; polymorphous, short bacillus, Gram positive. Liver abscesses: streptococcus and same bacillus as above.

Case XII. (from service of Dr. Howard Lilienthal). *Suppurative pylephlebitis following appendicitis; hepatotomy and drainage; death.*—Foster R., aged forty years, lawyer, admitted August 20, 1902. Four weeks prior to his admission had been operated upon for the removal of a gangrenous appendix. Fever continued high after the operation; four days thereafter he had a severe chill which was followed by a temperature of 105°. Thereafter he had repeated chills; temperature fluctuated between 97° and 105° F. On admission general condition was poor; temperature 104° F.; pulse 104; general icterus. Liver much enlarged, extending from fourth rib to the crest of the ilium. Free margin of liver tender; numerous friction rales over the dome of the liver. In the right iliac region was a large granulating wound and a sinus led downward to the pelvis, from which there was a profuse discharge of thin pus. Aspiration of the liver yielded thick, reddish pus.

August 21st. Gas and ether anæsthesia; transpleural hepatotomy; evacuation of small abscess; collapse and death.

Autopsy. Slight icterus, pus oozing from old appendicitis sinus.

In the mesentery are large intercommunicating abscesses containing thick pus, connected by suppurating tracts which seem mainly to involve and correspond to veins; abscess also involves the lymph nodes. Veins near the site of the appendix (appendix is absent and stump covered by adhesions) do not contain pus, but are closed by firm, red thrombi; superior mesenteric vein closed by purulent thrombus; portal vein almost entirely closed by purulent thrombus extending into branches in the liver. Around branches are a large number of closed abscesses varying in size from a pinhead to 5 cm. in diameter. Some contain green pus; some brown. No pus in the subphrenic space. Liver as a whole congested and markedly cloudy. Lung: pneumothorax on right side; lung collapsed. Spleen: acute septic. Kidneys: chronic interstitial nephritis; adrenals and pancreas negative. Bacterial examination: pus in liver; streptococci only in spreads; cultures: mesenteric abscess; spreads: streptococci and bacilli holding Gram stain; in cultures, bac. coli.

(*c*) *Suppurative Thrombosis of Radicles of Mesenteric Vein.*

Case XIII. *Perforated empyema of appendix; purulent thrombosis of vessels of appendix and neighboring cæcum; appendectomy; removal of mesenteriolum; incision and drainage of thrombosed veins; cured.*—Isaac G., aged twenty-seven years, a presser, had never been ill until the present time. Thirty-six hours before admission he began to suffer with severe abdominal cramps; vomited repeatedly; was chilly at the onset. During his transportation to the hospital the abdominal pain subsided very materially. On admission, December 9th, he looked very sick. His internal organs were normal; the abdomen was rigid and tender all over, but especially so in the right iliac fossa; free fluid in both flanks. Rectally, a tender area high up on the right side could be palpated; temperature 104° F.; pulse rate 82. Diagnosis: acute appendicitis; peritonitis. Immediate laparotomy; free exudate in the peritoneal cavity; there was a localized, thick, tenacious, but odorless encapsulated exudate in the right iliac fossa below and external to the caput coli. The appendix was found internal and below the caput coli curled up in a semicircle. It was perforated, and from the hole

brownish pus exuded. The mesenteriolum was infiltrated with pus and the purulent infiltration extended up to the adjoining vessels of the cæcum. The appendix with its mesenteriolum was deligated and removed. The purulent veins of the caput were incised, curetted, and drained. During this part of the manipulation the cæcum was punctured and at once closed by Lembert sutures. Drainage of stump of mesenteriolum, appendix, and cæcal region; closure of the rest of the wound. The temperature fell after operation to 100° F. and then rose to 102.2° F., and continued for the next ten days between 100° and 101° F. There was a profuse purulent discharge from the drainage opening for a week; thereafter rapid closure of the wound. The convalescence was interrupted by a rather severe attack of tonsillitis. Discharged cured, February 2, 1902.

Case XIV. *Acute gangrenous appendicitis; thrombosis of veins of mesenteriolum of appendix and adjoining veins of cæcum; appendectomy; drainage of thrombosed veins; cured.*—J. G., aged twenty-four years, a canvasser, was never sick until thirty-six hours before his admission. During the first twelve hours he felt chilly at intervals and suffered with pains in the right iliac fossa; during the last twenty-four hours he had two severe chills and vomited repeatedly, the pain in the right iliac region remaining constant. On admission, April 26, 1902, temperature was 102.4° F.; pulse 108. He was well nourished. Internal organs were normal. The lower half of the right rectus was slightly rigid. Exquisite tenderness from McBurney's point downward and inward to the pubis, but no distinct mass was to be felt. Rectally, nothing except distended intestines could be palpated. Diagnosis: acute appendicitis; probably venous thrombosis. Immediate laparotomy was proceeded with. Just before taking the anæsthetic the patient had a very severe rigor. The appendix was located anteriorly to the caput coli, lying free and surrounded by omentum. It was two and one-half inches long, dusky in color, and completely gangrenous. The vessels of the mesenteriolum contained purulent thrombi. The vessels of the caput coli could be palpated as rigid cords. This rigidity extended well up along the ascending colon. The appendix

was delivered from its omental bed, its mesenteriolum was deligated at as high a point as was possible, and the appendix, after ligating its base, was removed. In the stump of the mesenteriolum could be seen the purulent thrombi in the veins. The veins in the stump and in the adjoining portion of the cæcum were slit up and drained by gauze, and the wound was closed. The patient reacted well; temperature fell during the next twenty-four hours to 99° F.; the pulse rate to 72; with chilly sensations it rose suddenly in the next four hours to 103° F., pulse rate 92; it then declined rapidly to 97.8° on the third day; thereafter it fluctuated between 99° and 100° F. There was a profuse purulent discharge from the drain opening for ten days; thereafter the wound healed rapidly.

TOILET OF THE PERITONEUM IN PERFORATION OF THE INTESTINE FOLLOWING TYPHOID FEVER.

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It must be borne in mind that when the surgeon has to deal with these cases they are always of such a grave character that their condition cannot be regarded as other than desperate. Therefore the technique must be of such a character as to be rapid and thorough both as to the closure of the perforation and the complete elimination of all septic and extraneous matter which has escaped from the intestine, or purulent exudate which has been deposited in the peritoneum as the result of a general infection.

We shall exclude everything relative to diagnosis and confine ourselves simply to the technique of the operation, and deal with the conditions usually found in this class of cases.

In about 95 per cent. of cases operated upon it will be found that the incision is best made along the edge of the right rectus muscle, below the level of the umbilicus; this will lead down to that portion of the intestine where the lesion is most likely to be found. Out of 332 cases which we have carefully analyzed, in 96 the incision was made in the median line, with a mortality of 78.12 per cent.; where the right lateral incision was employed the mortality was 68.37 per cent.; in the remaining cases the site of operation was not mentioned. If after opening the abdomen evidences of perforation are present and the site of perforation not located, a median or left-sided incision can be made, so that all portions of the small and large intestine can be carefully explored. Out of 181 cases in which the seat of perforation was stated it was found that 75.13 per cent. were situated within twelve inches of

the cæcum, 19.88 per cent. within twenty-four inches of the cæcum, 3.86 per cent. within thirty-six inches of the cæcum, and 1.1 per cent. over three feet from the cæcum.

It is a good rule to make the incision directly over that portion of the bowel which is most likely to be affected, and at once expose the head of the colon, starting at the ileocæcal juncture. The last three feet of the ileum are then examined, and finally the ascending colon as far as it can be exposed. If no signs of peritoneal infection are discovered during this examination an error in judgment has been made, and further interference should be discontinued. If, however, signs of peritonitis are present and the perforation has escaped perception, the search should be continued by making a median incision and exploring the entire colon and sigmoid flexure. A perforation may escape detection by lying hidden behind a piece of lymph, and therefore all areas that are indurated or covered with lymph should be carefully examined.

Time will be saved when enfolding the coils of intestine if the opposite side of the bowel is carefully inspected by an assistant as it passes through the hands of the operator. Often the lesion has been found as a small dark spot about the size of a quill, through which a little fecal matter may be exuding. In several instances nothing was discernible except a little punched-out opening partially covered with lymph. Such a condition is liable to escape detection except where the greatest care is observed in seeking for it. The perforation should be closed with a silk suture, either transversely or longitudinally, so as to produce as little stenosis of the bowel as possible. A double row of Lembert or mattress sutures is all that is required, and can be rapidly placed without any undue elaboration.

Excision of the ulcer before suturing it is useless, and consumes valuable time. Rarely is the opening of such size that its closure will encroach upon the lumen of the bowel. In case the whole ulcerated area is large or the tissues too friable, and closure of the involved area is impracticable, a plug of omentum may be fashioned to fit the opening, and retained there by stitches, forming a simple patch or plug. Or, if there are several neighboring or con-

fluent perforations, or the integrity of a considerable portion of the bowel is impaired by deep ulceration not yet perforated, it is wise to secure this portion of the intestine to the edge of the wound rather than consume too much time in an elaborate method of closure. Sometimes dark necrotic spots will be found where the ulcer has destroyed the bowel down to the peritoneum, and which would probably be the site of a second perforation in a short time. Such suspicious places should be treated as though a perforation had taken place, and these weakened areas fortified with stitches. In the final toilet these suspicious areas can be so isolated by carefully placed pieces of gauze that should a second perforation occur the peritoneal cavity will be thoroughly protected from any escape of infective material. If in an exceptional case the perforation has produced a well walled-off abscess cavity, as is seen in appendicitis, the cavity can be sponged out and drained contrary to the best methods of dealing with appendicular abscesses.

It has been advised that when the infected portion of the peritoneum is limited to the right lower quadrant of the abdomen the intestine should be brought outside of the wound and carefully cleansed with normal salt solution and gauze sponges, while the cavity within is sponged dry without flushing, and a drain, either of a glass tube or gauze, or both, should be carried down to the pelvis. We, however, prefer douching with large quantities of hot salt solution during the process of closing the perforation, and a most thorough douching of the abdomen with salt solution, then equal parts of salt solution and hydrogen peroxide, and finally with normal salt solution at a temperature of 115° F., through a large irrigating tube, with the perforation so arranged that the current of the fluid is always toward the abdominal opening. This will facilitate the washing out of the abdomen without disseminating the septic material through the other portions of the peritoneal cavity.

If extensive peritonitis is present, one must treat the complication as seen. This will vary greatly according to one's individual beliefs. We are disposed to question the advisability of extensive intestinal manipulation or evisceration through a second or median

incision as being of doubtful wisdom unless the patient's condition is unusually favorable. We prefer to depend upon thorough prolonged irrigation, with the hand of the operator in the abdominal cavity gently separating the folds of the intestine, so as to permit the irrigating fluid to come in contact with all portions of the infected surface. As before stated, the abdomen can be drained with either a glass or rubber drainage tube. In our judgment the use of large pieces of gauze carried well down to the pelvis is preferable, other pieces being distributed through different parts of the abdomen in such a way as to pretty thoroughly close the abdominal wound and prevent any escape of the intestine. Over this should be placed a liberal gauze dressing, which will aid materially in the draining process. If the wound has been unusually large it can be reduced by the introduction of a few through-and-through sutures at its upper angle.

It is wise to leave the seat of perforation or doubtful portions of the bowel near the incision, and also to leave the gauze drain so that, if possible, it can forestall the disastrous consequences of insecure suture or a subsequent perforation. These pieces of gauze should be allowed to remain in the wound for three or four days. Their removal may be facilitated by thoroughly saturating with either salt solution or hydrogen peroxide.

It is imperative that the operation be done as rapidly as possible. The incision, the search for the perforation, and the repair of the perforation can all be very rapid and at the same time thoroughly performed. The careful and thorough irrigation, however, is a matter that must not be unduly hurried, though time can be saved by using a large and suitable irrigating tube which will admit of a large volume of fluid passing through it at one time. Cases are sacrificed through lack of proper irrigation, owing to the overwhelming desire of the operator to complete the operation in as short a time as possible. We would urge the greatest speed during the really operative part of the procedure, but would deprecate the hurried and inadequate cleansing of the abdominal cavity by douching.

THE TOILET OF THE PERITONEUM IN APPENDICITIS.

By STEPHEN H. WEEKS, M.D.,
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It is obvious that the toilet of the peritoneum will not be the same in all cases of appendicitis requiring operation. In the first place, I shall consider the method to be pursued in cases where there is no pus, as in the stage of quiescence, during the interval of attacks, and, second, in cases of appendicitis where there is a circumscribed area of suppuration, the general peritoneal cavity being shut off from the localized abscess; third, where the abscess wall is adherent to the abdominal wall in front, and, fourth, where there is general peritonitis with diffuse suppuration, with no protecting wall.

Whenever the appendix is removed in chronic appendicitis or in the period of health, between the attacks, drainage is not usually necessary; but when there is the least question as to sepsis about the appendix, either from inspissated remains of an abscess, from lymph, or from other appearances, a small wick of sterile gauze should be placed in contact with the suspicious area.

This strip of gauze should be removed in twenty-four or forty-eight hours and the opening closed by tying the provisional suture left in at the time of the operation. If the gauze wick is wet with normal salt solution before it is introduced into the wound and the first layer of the outside dressing is also wet and placed directly over the wound, coming in contact with the protruded end of the gauze, capillary drainage is much more active than if the gauze is applied dry. In operating for the removal of the appendix in the period of health the appendix should be tied close to the cæcum

with catgut ligature and cut off beyond the ligature, and the stump, including the mucous membrane, cauterized with 95 per cent. carbolic acid.

When practicable, the stump of the appendix should be buried by infolding it into the wall of the cæcum by a purse-string suture passing through the superficial layers of the cæcum a quarter of an inch distant from the base of the appendix. The purse-string suture is to be tied, the instrument used for invagination being withdrawn at the moment of tying. In suitable cases this is a very neat and perfect method; but when the stump is rigid or is much diseased such invagination or infolding is impossible, or when the stump is thick and hard and the calibre narrow, the attempt at invagination may result only in depressing the whole stump into the wall of the colon. The remnant of the appendix might under such conditions entirely fail to drain into the cæcum, and abscess in the wall of the colon with subsequent complication might ensue. Infolding or covering the stump is probably unnecessary, for cases in which a technique is impossible seem to progress equally well. Some surgeons make near the base of the appendix a cuff of peritoneum which is inverted and used over the stump.

Under the second head I shall consider the management of a circumscribed abscess in cases of acute appendicitis. In general I advise against irrigation—although this is practised by some surgeons—and especially against the use of antiseptic fluids, such as bichloride solutions.

The wounds and pus cavities can be better and safer cleansed with small sponges or gauze pads wrung out of hot sterile salt solution. Much better results are obtained in this manner than by vigorous irrigation. If irrigation is used the force of the stream may spread infection among healthy intestines.

The whole wound, including abscess cavity, if it exists, and the neighborhood of the stump of the appendix having been gently and thoroughly cleansed and dried out, the dressing is to be applied. The wound and abscess cavity should be filled, but not stuffed to distention, with plain sterilized gauze. All parts of the wound which have been infected should be subjected to gauze drainage.

To facilitate the removal of the gauze drain it may be made by rolling a piece of sterile gauze in gutta-percha tissue. This can be made in a few minutes of any size. Only that portion of the gauze that is to lie in the uninfected tissues should be covered with the gutta-percha tissue. In some cases, where the entrance to an abscess cavity is so small or the depth and extent of the cavity so great that the surgeon is in doubt as to the completeness with which the gauze has been introduced, the drainage tube may be used alone or in combination with the gauze with great advantage, giving additional security against a deep collection of pus.

Another advantage in the use of drainage tubes is seen when the gauze is removed, the intestines fall together, rendering it very difficult to repack with gauze; whereas when the drainage tube is used alone or in conjunction with the gauze, it can remain, through which daily irrigation can be made either with sterile salt solution or half saturated solution of boric acid, thus washing away all pus accumulations from the deeper parts of the cavity. In young children repacking with gauze becomes a very difficult matter, whereas, if the tubes have been used in addition to gauze, the cleansing of the cavity becomes a simple and painless operation. While it is not the intention of this paper to discuss the question whether or not the appendix should be removed in all cases of circumscribed suppuration, I wish to say that in most cases the appendix can be removed. It should be tied through its base and through its mesentery with catgut; silk becomes infected and causes a sinus which persists until the silk ligature is cast off. The appendix should be removed whenever it is possible to do so without infecting the abdominal cavity. In those operations in which the peritoneal cavity is necessarily opened no further harm can follow the removal of the appendix itself.

In some cases the appendix is so closely identified with a part of the wall of the abscess that to remove it would be to incur the grave risk of infecting fresh tissues beyond it. The appendix may in some cases even escape detection at all. It must depend upon the judgment of the operator whether in such instances it is best to insist on the removal of the appendix, or its removal at any risk,

no matter how difficult or prolonged the dissection, or to leave it, and trust to the reparative work in the wound-healing to render it harmless by obliteration. I have followed this course in many cases, and very rarely have I seen any trouble follow, and very rarely have I been obliged to operate a second time for the removal of the remainder of the appendix. Just how much primary closing of the wound will be safe must depend on the experience and judgment of the surgeon. This certainly is true, that the life of the patient who has been operated on for acute appendicitis with more or less infection of the adjacent peritoneum is safer when the wound is left open and abundant gauze drainage is made use of than it is when drainage is limited and the wound too much closed. The deep packings in the wound are to be removed at the end of the second or on the third day. This is quite painful, but with a little patience the packings can always be loosened and taken out. Sometimes, with an unmanageable child, it is necessary to give a little ether or chloroform in order to make the change of dressings properly. The wound is now to be gently mopped out and cleansed with slightly moistened pledgets of cotton or with sterile gauze, and is again repacked, this time considerably less gauze being introduced. A similar change of dressing should be made every second or third day, the quantity of gauze rapidly growing less as the wound closes from the bottom.

Another class of cases are those in which abscess formation so approaches and involves the anterior wall of the abdomen that the abscess may be opened without involving the non-infected peritoneum.

The tumor in these cases is generally a week or more old, and usually lies close to the outer half of Poupart's ligament. Occasionally the tumor approaches the anterior wall of the abdomen above and behind the anterior spinous process of the ilium, or nearer the median line and away from Poupart's ligament, or quite in the hypogastric region above the bladder. With care such an abscess can be opened without entering the uninfected peritoneum, as the abscess wall in front is firmly adherent to the anterior abdominal wall. It is very desirable in these cases to establish a large

entrance to the abscess cavity, not only that the contents may be completely evacuated, but that subsequent treatment may be facilitated. Careful search should be made with the finger for fecal concretions or foreign bodies, as the neglect to find and remove them may lead to inveterate sinus.

The appendix may have entirely separated and escaped with the fluid as a soft slough, or the larger portion of it may be still alive and firmly attached.

If the appendix can be found and removed without dangerous dissection it should certainly be done, the stump being ligated with catgut and cauterized with pure carbolic acid. It is not necessary, in abscess cases which are to be packed with gauze, to make use of any more complete method of closing the stump. If no portion of the stump remains sufficient to allow of the application of a ligature the edges of the orifice should be inverted and carefully overstitched. If the search for the appendix and its removal would clearly endanger the abscess wall it should be left *in situ*. As I have said before, the life of the patient is the first consideration, and should not be subjected to too great risk for the sake of removing the appendix. The appendix is very often completely destroyed, it is often obliterated by the process of repair, and if it remains and subsequently gives trouble it may be removed by a second operation when the conditions are much more favorable.

Not a few patients have been sacrificed to over-thorough work in handling abscess cases. In children especially, when the abscess is large and the patient feeble and much exhausted, the best and safest practice is to do little more at first than to give free exit to the pus.

The greatest care should be taken not to break down the wall of the abscess at any point so as to endanger the general peritoneal cavity. The cavity should now be gently sponged out and very gently irrigated, preferably with hot sterile salt solution. It should then be packed with sterile gauze, and the packing should be continued until the abscess cavity has filled in by the process of granulation.

Another and a very important class of cases includes those in which the protecting wall of adhesions is either entirely absent or more or less incomplete. In these cases a more extensive involvement of peritoneum than is usual has taken place and is rapidly progressing, and the products of a septic peritonitis have flooded the pelvic cavity or passed upward toward the liver, or have invaded the whole general peritoneal cavity.

If not recognized before operation this condition is usually readily ascertained as soon as the abdominal cavity is opened. The absence of a protecting abscess wall and the escape into the wound of septic fluid from various directions are clear indications that a widespread infection of the peritoneum has taken place.

In every case where the abscess wall is imperfect search should be carefully made for distant collections of pus; a sponge or pad of gauze held in a long sponge-holder pushed gently down into the pelvic cavity may reveal the existence of a large free collection of fluid. In such cases the peritoneum of the intestines contained in the pelvis will always be inflamed. In other instances it will be evident, as soon as incision is made, that the patient is suffering from a general septic peritonitis involving the entire cavity, the quantity of seropurulent fluid with pus and lymph masses being often very great.

All of these cases of commencing or widespread septic peritonitis require the complete removal of all septic fluid and the thorough cleansing of all inflamed peritoneum. Efficient drainage of the areas involved must be provided, as after operation the serous exudation is very abundant.

Free incision from four to five inches long is required in order that the intra-abdominal work may be rapidly and thoroughly accomplished. The appendix should be first isolated and removed and the stump cauterized, especially within; a single catgut ligature is sufficient to close the stump, as the wound will always be left open and packed.

More elaborate methods of closing the stump in this class of cases are time consuming and unnecessary. The neighborhood of the appendix is then to be carefully cleansed and search made for

concretions and other foreign bodies. Dr. Charles McBurney says, "For cleansing purposes in this class of cases nothing equals the hot sterile normal salt solution." This solution is entirely non-irritating to the delicate endothelium of the peritoneum, and washes, without damaging, the most delicate tissues. The temperature of the solution should be from 116° to 118° F., and this temperature may be sufficiently accurately determined with the hands. If the hand can bear to be continually immersed in the solution it is not too hot. It should be poured freely into the wound and removed with sponge or gauze pads until the area about the appendix is clean. If the pelvic cavity is found to contain fluid this should be thoroughly removed with gauze pads or sponges held in long sponge-holders. The hot salt solution should then be poured into the pelvis, and this again removed with sponges, and the washing repeated a number of times until the fluid returns clear. This process is facilitated and made more thorough if, while the solution is being poured in, a sponge in a long sponge-holder is thrust down to the bottom of the pelvic cavity and then drawn up and down very much like the piston of a pump. When the pelvis is thus cleansed every other infected area should be similarly treated, the intestines, if necessary, being drawn out of the wound. All of this work should be done as rapidly as is compatible with thoroughness, for patients who require such intraperitoneal washings are not in a condition to withstand prolonged anæsthesia and manipulation. Drainage should now be efficiently supplied. A glass drainage tube, open at both ends and with small openings in the sides and long enough to reach from the surface to the bottom of the pelvic cavity, should be placed in or near the lower angle of the wound. A single strip of sterile gauze is to be pushed into the tube from end to end. If a similarly infected area has been found extending high up to the right of the ascending colon it should be treated in the same manner, and strips of sterile gauze packed in in considerable quantity beside the tube. Here the tube may be often omitted if free packing is made. If the whole peritoneal cavity has been invaded, the surgeon should pass strips of gauze in various directions among the intestines, so that perfect

capillary drainage may be furnished throughout. Lastly, the whole neighborhood of the appendix stump and the whole wide-open wound is to be filled with gauze. In some cases a supplementary incision in the left iliac region is indicated. Here, also, gauze drainage should be used.

The glass drainage tube in the pelvic cavity should be swabbed out every four or six hours until found to be dry, and if the patient is doing well and the fluid is not found in the tube at the end of twenty-four or forty-eight hours it may be removed, a single narrow strip of gauze being left in its place. The gauze packing should not be removed until the end of three days, and some may resist extraction until the fifth or sixth day. When the deep packings are removed fresh ones should be introduced in their place, but in diminished quantity. Complete change of dressings should now be made every second or third day, the quantity of gauze being reduced on each occasion.

It is claimed that much better wound-healing is obtained if irrigations are entirely avoided. If purulent discharge continues abundant gentle swabbing with gauze wet with peroxide of hydrogen is valuable.

Summary. No one method of making the toilet of the peritoneum in appendicitis is suitable for all cases, for they vary much in the extent of operative work required and in the difficulties encountered.

When the operation is made before pus has formed, or during the interval between the attacks, no pus being present, no drainage is needed. The appendix being removed and the region dried with pads of sterile gauze, the external wound is completely closed.

In the second class of cases, where there is a circumscribed abscess, care should be taken not to infect the general peritoneal cavity by forcible irrigation, which is likely to force the purulent fluid among healthy intestines. The wounds and pus cavities can be thoroughly cleansed with gauze pads wet with sterile salt solution, and sometimes wet with peroxide of hydrogen, diluted with an equal part of sterile water. In such cases, where the general peri-

toneal cavity is opened, the appendix can generally be found and should be removed. The wound and the abscess cavity should then be packed with sterile gauze.

In the third class of cases the wall of the abscess is firmly adherent to the anterior wall of the abdomen, and can be opened without opening into the uninfected abdominal cavity. This point of adhesion should be carefully searched for and the abscess opened at this point. Careful search should be made for concretions, as the neglect to find and remove them may lead to a troublesome sinus.

Here the abscess cavity should be carefully evacuated and cleansed with gauze pads, or irrigation, which can be safely used without fear of infecting the healthy peritoneum, after which the whole cavity is packed with gauze. In these cases the greatest care should be taken not to break down the wall of the abscess at any point.

The fourth and a very important class of cases includes those in which there is no protecting wall of adhesions and the products of a septic peritonitis have flooded the whole abdominal and pelvic cavities, and the intestines are floating, so to speak, in the septic fluid. All of these cases require the complete removal of all septic fluid and the thorough cleansing of all the intestines, which sometimes may require their removal from the abdominal cavity. This cleansing is best done by thorough irrigation, several times repeated. After thorough cleansing by irrigation and sponging a glass drainage tube open at both ends and a strip of gauze pushed into the tube from end to end should be passed well down into the pelvic cavity, and the whole infected area packed with sterile gauze. Strips of gauze should be passed in various directions among the intestines, so that perfect capillary drainage may be secured throughout.

TOILET OF THE PERITONEUM IN GUNSHOT WOUNDS OF THE STOMACH AND INTESTINES.

By GEORGE TULLY VAUGHAN, M.D.,
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By toilet is meant treatment of the peritoneal cavity after arrest of hemorrhage and the closure of the wounds in the viscera, and it involves especially a consideration of the questions as to the best method of *cleansing* and the conditions which demand *drainage*. The necessity for cleansing the peritoneal cavity after all such wounds is admitted—the only doubt is as to the best method—but the question of drainage is not so simple. It is often a puzzling question—one requiring considerable judgment—to decide whether to drain or not to drain.

The necessity for drainage should be undoubted, in order that its good effects may not be overbalanced by the manifest evils incident to its establishment, such as the risk of infection from leaving the wound open and the injury to the tissues from the pressure of a foreign body in the shape of gauze or drainage tube. There can be no doubt that if drainage is unnecessary the injury inflicted by the tube or gauze and open wound is a detriment to the welfare of the patient.

For purposes of consideration, with a view to determine the best method of cleansing and the indications for drainage, the cases may be divided into two classes—those *without peritonitis* and those *with peritonitis*.

Class I. includes:

a. Without extravasation of visceral contents.

b. With extravasation of visceral contents.

c. With considerable blood in the peritoneal cavity or incomplete hæmostasis.

Class II. includes:

a. Local peritonitis.

b. General peritonitis.

In *a* of Class I., when there is neither escape of visceral contents nor peritonitis, neither irrigation nor drainage of the peritoneal cavity is necessary. The danger of infection by bacteria which the missile may have collected in passing through the intestine, as shown by La Garde and others, is not great and may be ignored. As the number of such micro-organisms is apt to be comparatively small, they are overcome by the normal resistance of the patient. If in doubt, sponge off and irrigate with warm physiological salt solution.

b. When there is extravasation of visceral contents thorough cleansing of the peritoneal cavity is absolutely necessary. This is best accomplished by sponging followed by irrigation with large quantities of salt solution, removing the intestines from the cavity, if necessary and the condition of the patient will permit it. In all such cases, unless satisfied that the cleansing is perfect, drainage should be used and the gauze or tube should enter the most dependent part of the cavity to be drained, and this is the pelvis. In the female this is easily done by an opening through the vagina into the pouch of Douglas, and in the male perhaps the best method is that suggested by Hugh Taylor of tapping the rectovesical peritoneal pouch by an opening in the perineum between the rectum and the urethra.

When the wounds in the viscera are few and, with the extravasation of contents, limited to a small area, and the operation performed early—within an hour or two after the receipt of the wound—the parts should be cleansed by sponging and *local* drainage provided, irrigation and general drainage being unnecessary.

c. After severe hemorrhage with the formation of blood clots or if, for any reason, there has been imperfect hæmostasis, irrigation is indicated and perhaps general drainage to remove the bloody fluid, which would form too good a culture medium for germs to be allowed to remain.

Class II., *a*. In cases of *local peritonitis* the parts involved should

be drained. Irrigation must be used with caution, if used at all, lest other parts be infected by the breaking up of slight adhesions and the escape of the irrigation fluid perhaps conveying the germs to distant parts of the abdominal cavity. Generally it is advisable simply to provide drainage. In circumscribed abscess of the peritoneal cavity if the discharge continues unreasonably long the abscess may be washed out with bichloride solution, 1 : 5000. The following case shows the tendency to spontaneous recovery from a circumscribed abscess with opening of the intestine following a gunshot wound:

P. J., colored, male, aged twenty-eight years, laborer, native of Virginia, was shot January 8, 1903, at close range, the 0.38 calibre pistol-ball entering at the lower border of the fifth rib one inch to the inner side and one inch below the right nipple and lodging under the skin on the left side between the ninth and tenth ribs in the posterior axillary line, eight inches from the left nipple and eight and one-half inches from the anterior superior spinous process of the ilium, whence it was removed. The patient was admitted to the Emergency Hospital two days after the shooting.

He stated that he vomited two or three times soon after the shooting, but no blood was vomited or coughed up, or passed by the bowels or bladder. The patient's condition was good on admission to the hospital, but the wound was regarded as serious, since, from its course through the body, it must have passed through the liver and might easily have wounded also the base of the right lung, stomach, colon, and spleen; so the wounds were dressed antiseptically and he was kept in bed on restricted diet. A slight cough developed and a few rales were heard about the wound of entrance, but no consolidation could be detected. The patient complained chiefly of his limited diet. The pulse ranged between 84 and 116, the temperature between 100° and 103° F. Once it reached 104° F., and the next day, January 23d, fifteen days after the reception of the wound, a fecal odor was noticed, and, after removing the dressing over the wound of exit, fecal matter, evidently from the colon, and a considerable quantity of pus were seen escaping. The opening was enlarged by removing the two stitches which had closed

it. No treatment was used except to keep the parts clean by daily dressings, but the discharge ceased after ten days and the wound healed, the patient being discharged recovered February 10, 1903.

b. In general peritonitis from gunshot wounds or from any other cause—if by general peritonitis we mean inflammation of an infectious character involving the entire extent of the peritoneum—no treatment would be likely to cure. But, as it is usually impossible to know the extent of the inflammation, the patient should be given a chance for life by thorough irrigation and efficient drainage in the manner already described.

THE TOILET OF THE PERITONEUM IN OPERATIONS UPON THE GALL PASSAGES.

By EDWARD MARTIN, M.D.,
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The general principles applicable to all intraperitoneal manipulations practically cover the rules of conduct which should be observed during and after surgical intervention for the relief of pathological conditions of the bile passages.

Aside from surgical cleanliness, the most important factor, in so far as the prevention of excessive peritoneal reaction is concerned, is gentle manipulation. This implies a previous preparation of the patient which empties the stomach and intestines of gas. Thorough purgation, light diet, the administration of intestinal antiseptics, and gastric lavage will nearly always accomplish this.

The incision must be so placed, and must be of such proportions as to allow of easy access to the lesion. A vertical incision splitting the rectus muscle is usually adequate; sometimes it is needful to supplement this by a transverse incision. A huge incision, beginning at the ensiform cartilage and running to the crest of the ilium, is rarely needful, and is always difficult to close by layer sutures.

The position of the patient should be such as to bring the operative area near the surface. A sand-bag in the lumbar region generally accomplishes this. I have tried the reversed Trendelenburg position, but without deriving any help from it. Traction upon the gall-bladder and round ligament is distinctly useful, and will sometimes render incision and suture at the junction of the hepatic and cystic ducts practically extra-abdominal.

One careful placing of the abdominal pads is desirable, since

repeated withdrawal and replacing inevitably produces a traumatic reaction. I have found gauze pads, containing in their centres sheets of lead plate, useful in keeping the stomach and colon from encroaching upon the operative field.

All the measures above mentioned have for their end the avoidance of rough handling. A further means of lessening pure traumatic reaction is based, on experimental evidence at least, in the use of hot normal saline solution, from which the pads are wrung out before being used intraperitoneally.

As an essential part of the toilet of the peritoneum, the avoidance of infection through escaping bile must be carefully considered. This is accomplished by a careful placing of pads until adequate drainage is provided for.

The flushing of the operative area with large quantities of normal saline solution is, as a rule, to be avoided, and should be practised only when there has been a large escape of probably infected bile beyond the region protected by the gauze pads.

The question of drainage is, perhaps, the one of paramount importance in operations upon the gall passages, as it is indeed in all intra-abdominal operations. The tendency of the day is toward the routine abolition of the long-continued peritoneal drain.

In uncomplicated operative cases where there are few adhesions, little or no oozing, no rough handling, and where, for instance, a stone in the common duct has been easily removed, the incision through which it has been taken out having been closed by properly applied sutures, the opening of this common duct into the duodenum having been previously determined to be patulous, I believe that drainage is quite as unnecessary as it would be in the case of suture of an incision into a healthy bladder.

Where there have been extensive adhesions and, consequently, free oozing, other conditions being as just described, I believe gauze and tube drainage is indicated for a period of not more than six hours, since the only purpose of such drainage is to prevent the collecting of blood which may subsequently become infected and form an abscess, or, in case organization and absorption take place, may form adhesions which will give rise to symp-

toms much more distressing than those for which the original operation was undertaken.

When the biliary passage has been opened and suture is either impossible or inadequate, there can be no question as to the desirability of drainage, which should be by means of a tube sewed by catgut in the area it is desired to drain, and by gauze packed about this tube in such a way that the general peritoneal cavity is protected from escaping bile.

This particularly holds true when the conditions are such as to lead the surgeon to suppose that there is an acute infective condition present. Such drainage should be removed as soon as possible; the gauze in twelve to twenty-four hours, being then replaced by a tube. The longer the tube and gauze are allowed to remain in place, the more surely will adhesions subsequently form. These, as a rule, are harmless; exceptionally they so seriously interfere with function as to require a second operation. In suture of the gall passages without drainage it would seem wise, as a rule, to drain the gall-bladder, thus lessening the tension due to back pressure, which certainly takes place in the common duct, and which readily might interfere with the integrity of the line of suture. Where there is reason to expect an abundant and continuous flow of bile from artificial openings in the gall passages, the use of the omentum (so stitched that the general peritoneal cavity is protected) seems desirable.

THE TREATMENT OF THE PERITONEUM IN DIFFUSE PERITONITIS.

By JOSEPH A. BLAKE, M.D.,
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From the standpoint of therapy, the classification of the purulent forms of peritonitis by the specific nature of the bacterial invasion is not of so much importance as that based upon the progress and extent of peritoneal involvement. Therefore, it has been my custom to classify these cases in the following groups 1. Cases with abscess, in which there is a localized collection of pus with limiting adhesions. 2. Cases with spreading peritonitis, in which there is no limitation of the process by adhesions or gravitation, but in which the limits are ascertainable. 3. Cases of general peritonitis, in which no parts of the peritoneum, possibly excepting the lesser sac, can be demonstrated as free from the invasion. The two last groups are comprised under the general term, diffuse peritonitis.

In my report of cases I have held rigidly to this classification and I have included in my cases of spreading peritonitis cases which would ordinarily be considered to be cases of general peritonitis. I have also excluded a number of cases which recovered and in which the process was spreading, but was not extensive. In other words, the cases of spreading peritonitis here presented would, in so far as I can judge from my experience, all have become generalized in a few hours, and further all presented the symptoms of a generalized peritonitis before operation. I particularly emphasize this point since these cases are of especial interest in regard to certain questions of treatment. All the cases have been operated upon by myself and comprise all the cases of general and spreading

peritonitis arising from all causes that I have met with in the last two and one-half years, excepting those occurring in connection with new-growths and intestinal obstruction where the primary disease overshadowed the secondary peritonitis.

In three actually moribund cases, one from appendicitis and two from the perforation of typhoid ulcers, I have refused to operate, and these cases died within a few hours of the time I first saw them; but, on the other hand, I have been led to operate upon a number of moribund cases by the recovery of some cases that seemed positively hopeless.

It is not my aim to advance anything new in the treatment of these cases or to claim anything unusual in the way of results, but to simply report the cases and give the reasons that have led me to the treatment I now employ. I have chosen the cases occurring in my practice during the last two years and a half, since they have been operated upon under practically the same conditions and therefore are better for comparison.

The cases have been tabulated and are appended. They comprise seventeen cases of spreading and fifteen cases of general peritonitis. Of the cases of spreading peritonitis, ten were caused by appendicitis, of which ten recovered and none died; one by perforating typhoid ulcer, no recovery, one death; four by perforating ulcer of the stomach or duodenum, of which two recovered and two died, a mortality of 50 per cent. (the deaths were both attributable to sepsis from the local condition); two from gonorrhœal infection, both recovering from the peritonitis, but one dying later, on the thirty-fifth day after operation, from an obscure pyæmia. Of the cases of general peritonitis, seven were caused by appendicitis, of which three recovered and four died, a mortality of 57 per cent.; one by perforating typhoid ulcers, one recovery, no death; one by perforating tubercular ulcer, no recovery, one death; six by infection through the Fallopian tubes, one of which was probably a pneumococcus infection, one a mixed streptococcus and gonococcus infection, and the remainder gonorrhœal, of which one recovered and five died, a mortality of 83 per cent.

The latter six cases with the two cases of spreading gonorrhœal

peritonitis form a rather remarkable series of eight cases of tubal infection and deserve a more extended description than I can afford them in this paper. I regret exceedingly that an absolute bacteriological diagnosis was only made in four of them; in three of the remainder I was led to believe that the infection was gonorrhœal from the clinical evidence. The high mortality was due largely to a condition of extreme sepsis; in one case death occurred from a postoperative volvulus apparently induced by a congenital anomaly of the large intestine.

In the treatment of these cases I have endeavored to carry out two principles: firstly, the removal or segregation as quickly as possible of the cause or nidus in order to prevent further peritoneal and systemic infection; secondly, the placing of the peritoneum under the best possible conditions to withstand and eliminate the generalized infection.

In regard to the propriety of the first principle, which in other words is early operation, I think there is no question, possibly excepting the cases of peritonitis arising from appendicitis.

I myself cannot see the difference between a case of extensively spreading peritonitis caused by infection from the appendix and one arising from any other cause, and, further, I cannot believe that such an extensive peritonitis can be localized or arrested by any form of treatment other than operation.

I operate on these cases as soon as they can be prepared, believing that with the cause and the major portion of the toxic effusion removed the peritoneum is placed in a much better position to eliminate and destroy the remaining infection.

I think that any of the advocates of the treatment by rest will concede that the patient would be much better off with the appendix out, if that could be done without operation.

We have then simply to weigh the dangers of the additional toxæmia of the anæsthetic and the shock of operation against the danger of continued infection, both systemic and peritoneal, from the appendix itself or the escape of its contents.

With a short anæsthesia and a quick operation the danger of interference is much less than that of procrastination. There need

be no fear of spreading infection since that has been already accomplished. We have not so much the peritoneum to fear as we have the systemic infection through the lymphatics and vessels of the meso-appendix. Furthermore, I believe that an inflamed peritoneum is far better able to withstand an augmentation of the infection than a healthy peritoneum the scattered contents of a quiescent abscess. The proper time for the rest treatment in these cases is after the appendix is out and the peritoneum cleansed. I think the cases of spreading peritonitis caused by appendicitis which I report support my contention. These were all cases of extensive spreading peritonitis, ten in number, and all recovered. If we add the cases of general peritonitis in which the whole of the greater sac was demonstrated to be involved, seven in number, the total is seventeen cases operated upon with four deaths, a mortality of 23.5 per cent. Adding one moribund case dying without operation, the total mortality is 27.7 per cent.

The second principle involved in the treatment, namely, the placing of the peritoneum under the best possible conditions to withstand and eliminate the generalized infection, involves two main questions, namely, the cleansing of the peritoneum and the employment of drainage.

In regard to the cleansing of the peritoneum, I have consistently done it, employing for this purpose large quantities of decinormal saline solution at a temperature of 110° F., and consequently have nothing to say about the results obtained by not cleansing or by cleansing by other methods.

I have introduced the solution with a very large glass tube or have poured it in with a pitcher. In most instances I have partially dried the peritoneum afterward with sponges or large rolls of gauze, or, on the other hand, have left considerable quantities of the solution in the cavity without apparent difference in the results. I am inclined to the latter procedure, since unnecessary handling of the intestines and prolongation of the operation is thereby avoided. My reasons for preferring washing are: that it can be carried out through a relatively small incision; that the peritoneal endothelium is less injured, and that the toxins are more readily diluted and

removed. All loose fragments of fibrin are sluiced out, but the adherent portions are left.

In considering the questions of drainage the cases are best divided into groups, one including those in which the focal cause or origin can be removed or eliminated, the other the remaining cases.

To the first group would be assigned most cases of peritonitis arising from perforation of the hollow viscera, appendicitis, salpingitis, and possibly cholecystitis; to the second those resulting from rupture of abscesses, pancreatitis, and cholecystitis in which cholecystectomy was contraindicated.

In the first group drainage may or may not be employed; in the second it is, as a rule, necessary.

I was formerly a warm advocate of abundant drainage; later I became convinced of the utter impossibility of draining every part of the peritoneal cavity, for it was evident that the drains were soon isolated by adhesions; so I next confined myself to the drainage of the field of operation, and then perceiving that the other similarly affected regions of the peritoneum took care of themselves, I omitted drainage almost entirely and only employed it when the presence of necrotic tissues or hemorrhage demanded it.

A comparison between the cases in which drainage was employed and those in which it was omitted is of interest in regard to the occurrence of complications and the duration of convalescence.

One of the principal advantages that non-drainage has over drainage is the avoidance of intestinal obstruction. Intestinal obstruction may be caused by the direct pressure of the drain on the intestine or by the production of adhesions about the site of the drain. Adhesions no doubt occur when no drains are used, but they are undoubtedly increased by their presence.

The only case in this series in which obstruction occurred which could be directly attributed to the drainage was Case 3, of spreading peritonitis following appendicitis. In this case a glass tube was used, passing to the pelvis, and the incessant vomiting and distention from which the patient suffered disappeared immediately on removal of the tube. Although this is the only accident of this kind appearing in this series, I have observed it several times in

other cases. It has, however, seemed to me that there has been much less postoperative meteorism and vomiting in the cases not drained than has been the usual experience when drainage has been employed.

A not infrequently observed complication has been the formation of localized collections of pus in various parts of the peritoneum during convalescence.

This is apparently due to the inability of the vital forces to overcome the entire infection and consequently more or less isolate patches of unresolved inflammation are left behind.

These collections do not always occur in the natural pockets or fossæ of the cavity, and so cannot be entirely explained by gravitation of the exudate. For the same reason they cannot be prevented by drainage as usually employed. These abscesses were observed in four cases, twice in drained and twice in undrained cases. In one drained case (13) a case of spreading peritonitis due to gastric ulcer, a subphrenic abscess developed from direct extension from the area of drainage in front of the stomach. Probably the aspirating movements of the diaphragm were much to blame for this. In the other drained case, a case of general peritonitis due to appendicitis, a pelvic abscess was opened on the thirty-seventh day after operation. In this case it might be attributed to the irritation of the drain, which passed to the pelvis, and its too early removal.

Both of the undrained cases developing late abscesses were cases of appendicitis; one with spreading peritonitis developed a subphrenic abscess; the other, an extreme case of general peritonitis, developed two abscesses in the fourth and fifth weeks of convalescence, situated among the coils of the intestines to the left of the umbilicus.

Drainage would probably not have prevented these abscesses. Of the ten cases closed without drainage four developed suppuration of the parietal wound. In one of these the superficial wound had been drained, but insufficiently. One other case of general peritonitis from the perforation of three typhoid ulcers of three days' standing, in which I had inserted a small cigarette drain into the pelvis, leaving it only for two days, also developed suppuration of

the whole parietal wound, while the peritonitis went on to complete resolution.

When I close the peritoneum in these cases I now fully drain the parietal wound down to the peritoneum.

A comparison of the duration of convalescence in the drained with that in the undrained cases shows that the average duration of convalescence in all the drained cases was 43.4 days, in all the undrained cases 25.3 days—an average saving to each of the undrained cases of eighteen days. One of the drained cases (25) is omitted, since his typhoid delayed his convalescence. A fairer comparison is obtained by taking only the cases of appendicitis with spreading peritonitis, since it so happens that all of these cases could have been treated without drainage and that the other conditions were practically alike. In this group the average duration of convalescence of the drained cases was 34.7 days, of the undrained cases 21.8 days—an average saving to the latter of practically thirteen days.

In the same group of cases the average length of time elapsing before the temperature struck the normal was in the drained cases 8.5 days, in the undrained cases 3.8 days—a very marked difference in favor of the latter, showing how much shorter septic absorption lasts in the cases treated without drainage.

A comparison of the mortality in the cases treated by drainage and those without drainage would obviously be unfair unless we group the cases according to the causative diseases, and even then is unsatisfactory because the numbers are so small.

The only considerable groups are the cases of spreading peritonitis arising from appendicitis, ten in number, all of which recovered, showing no difference; the cases of general peritonitis arising from appendicitis, seven in number, of which five were drained with four deaths, and two were not drained, both recovering; and the cases of general peritonitis of tubal origin, six in number, of which five were drained with no recoveries, and one was not drained and recovered.

Two of the latter group were children, and, not wishing to remove the tubes, I drained the pelvis, hoping that the process would be-

come localized, thus making fatal mistakes. I also erred in some of these cases in my diagnosis and made lateral instead of median incisions, thus hampering myself and prolonging the operation. I now make it the rule, when operating on females, to make, in all cases in which there is the least doubt in diagnosis, a median incision.

A résumé of the treatment that has given the best results in my experience may be briefly stated as:

1. Early operation.

2. Lavage of the peritoneum with large quantities of saline solution.

3. Closing of the peritoneal cavity without drainage, unless the latter is absolutely indicated by the presence of non-absorbable amounts of necrotic material.

TABLE OF CASES OF SPREADING AND GENERAL PERITONITIS.—SPREADING.

No.	Age and sex.	Cause.	Duration.	General condition	Amount of peritoneum inflamed.	Exudate.	Drain.	Postoperative complications.	Temp. normal.	Duration of convalescence.	Result and remarks.
1	27 M.	Gang. appendicitis.	72 hrs.	Fair.	Lower half.	Seropus, fibrin.	Yes.	.....	10th day	30 days	Recovered.
2	26 M.	Perf. appendicitis.	42 "	Bad.	Lower two-thirds.	Pus, seropus.	Yes.	.....	10th "	27 "	"
3	29 M.	Gang. appendicitis.	48 "	Fair.	Lower half.	Seropus, fibrin.	Yes.	Intest. obstruction from pressure of drain.	11th "	43 "	"
4	60 M.	Gang. appendicitis.	36 "	Fair.	Lower half.	Pus, seropus.	Yes.	.....	3d "	39 "	"
5	21 M.	Gang. appendicitis.	30 "	Good.	Right half and pelvis.	Seropus.	No.	.....	3d "	16 "	"
6	16 M.	Gang. appendicitis.	48 "	Fair.	Lower two-thirds.	Pus, seropus.	No.	.....	3d "	16 "	"
7	23 F.	Gang. appendicitis.	24 "	Bad.	All except about liver and spleen.	Pus, seropus, fibrin.	No.	.....	4th "	19 "	"
8	11 F.	Gang. appendicitis.	24 "	Fair.	Right half and pelvis.	Seropus.	No.	.....	3d "	10 "	"
9	25 M.	Gang. appendicitis.	36 "	Fair.	Lower two-thirds.	Seropus, fibrin.	No.	Superficial w'd infection, subphrenic abscess.	4th "	47 "	"
10	23 M.	Gang. appendicitis.	26 "	Fair.	Lower half.	Seropus.	No.	.....	6th "	23 "	"
11	36 M.	Perf. typhoid ulcer.	26 "	Bad.	Lower two-thirds.	Pus, fibrin, feces.	Yes.	.....	.....	.....	Died in two hours.
12	25 M.	Perf. ulcer duodenum.	48 "	Fair.	All, except about spleen.	Pus, seropus, fibrin, intest. contents.	Yes.	.....	15th day	37 days	Recovered. Inversion ulcer with purse string.
13	20 F.	Perf. ulcer stomach, abscess; rupture abscess.	20 "	Bad, anæmic.	Upper half.	Seropus, fibrin, gastric contents.	Yes.	Subphrenic abscess.	4th "	.....	Died 10th day, sepsis; peritonitis resolved.
14	21 F.	Perf. ulcer stomach, abscess; rupture abscess.	6 dys. 12 hrs.	Bad.	All, except small portion lower regions.	Pus, seropus, fibrin, gastric contents.	Yes.	.....	.....	.....	Died 16th day, sepsis from abscess.
15	47 M.	Perf. ulcer pylorus.	7 "	Good.	Right side and pelvis.	Seropus, gastric contents.	No.	.....	6th day	22 days	Recovered. Excision ulcer, pyloroplasty.
16	20 F.	Tubal, gonorrheal(?).	48 "	Fair.	All, except about liver.	Seropus.	Yes.	.....	5th "	33 "	Recovered. No bacterial examination.
17	57 F.	Tubal, gonorrheal.	24 "	Good.	Right side pelvis and right femoral hernial sac.	Seropus.	Yes.	....	2d "	.....	Died 35th day, pyæmia; temp. normal for three weeks after operation.

GENERAL.

No.	Age and sex.	Cause.	Duration.	General condition	Amount of peritoneum inflamed.	Exudate.	Drain.	Postoperative complications.	Temp. normal.	Duration of convalescence.	Result and remarks.
18	23 F.	Gang. appendicitis.	72 hrs.	Bad.	Whole greater sac.	Seropus and fibrin.	Yes.	.....	.....	.....	Died on 3d day.
19	18 M.	Gang. appendicitis.	72 "	Bad.	Whole greater sac.	Pus and fibrin.	Yes.	Pelvic abscess at seat of drainage 37th day.	28th day	95 days	Recovered.
20	38 M.	Gang. appendicitis.	.....	Bad.	Whole greater sac; coils intestine appeared gangrenous in places.	Pus and fibrin.	Yes.	.....	.....	.....	Died on 3d day.
21	50 F.	Gang. appendicitis.	120 hrs.	Bad.	Whole greater sac.	Pus and fibrin.	Yes.	.....	.....	.....	Died. Only partial lavage; death in ten hours.
22	12 F.	Gang. appendicitis.	60 "	Bad.	Whole greater sac.	Pus and fibrin.	No.	Superficial w'd infection, pneumonia 10th day, two abscesses left side 4th week.	40th day	60 days	Recovered. Streptococcus and colon bacillus.
23	25 F.	Gang. appendicitis.	48 "	Fair.	Whole greater sac.	Pus, seropus, and fibrin.	No.	Superficial w'd infection.	5th "	20 "	Recovered.
24	68 M.	Gang. appendicitis.	80 "	Moribund.	Whole greater sac.	Pus and fibrin.	Yes.	.....	.....	.....	Died in 3 hours.
25	16 M.	Perf. three typhoid ulcers.	72 "	Bad.	Whole greater sac.	Pus, seropus, fibrin, feces.	Yes.	Superficial w'd infection.	3d day	52 days	Recovered. Small cigarette drain only; recrudescence typhoid 4th day.
26	24 M.	Perf. ulcer ileum, probably tuberculous.	48 "	Fair.	Whole greater sac.	Pus, seropus, fibrin.	Yes.	.....	.....	.....	Died 4th day.
27	6 F.	Tubal probably pneumococcus.	.....	Bad.	Whole greater sac.	Creamy pus.	Yes.	.....	.....	.....	Died 9th day; autopsy report pyæmia.
28	27 F.	Tubal, gonorrheal.(?)	144 hrs.	Bad.	Whole greater sac.	Pus.	Yes.	.....	.....	.....	Died 2d day, sepsis.
29	30 F.	Tubal, gonorrheal.(?)	36 "	Fair.	Whole greater sac.	Seropus, fibrin.	Yes.	Volvulus 3d day.	.....	.....	Death fol. 2d op. for intestinal obstruction; no bact. exam.
30	4 F.	Tubal, gonorrheal.	.....	Bad.	Whole greater sac.	Seropus.	Yes.	.....	.....	.....	Died in 24 hours.
31	13 F.	Tubal, gonococcus and streptococcus.	72 hrs.	Bad.	Whole greater sac.	Creamy pus.	Yes.	.....	.....	.....	Died on 4th day from sepsis.
32	18 F.	Tubal, gonorrheal(?).	96 "	Fair.	Whole greater sac.	Pus and fibrin.	No.	.....	.....	20 days	Recovered. No bacteriological examination.

DISCUSSION ON TOILET OF PERITONEUM.

Dr. John C. Munro, of Boston.

I want to say a few words in reference to Dr. Gerster's paper, as he speaks of the rarity of portal phlebitis following appendicitis. I do not think they are so rare, as I have had thirteen cases definitely proven at operation or autopsy, three probable cases, and, roughly, a dozen light cases at least, with spontaneous recovery, where the diagnosis cannot be proven. These cases occurred in my own practice, and do not include those seen in the practice of my colleagues. He refers to the chill, which I consider a very important symptom, although a very irregular one. In one of my cases plasmodia were present at the same time, the chills persisting in spite of quinine. The author states that these conditions occur in internal cases, but I do not think so, as I believe they are more common in the subacute cases. Infection from the retroperitoneal lymphatics is very important, and I would suggest this as the cause of death in some of the reader's cases, and not the infection from the portal system. The liver is not necessarily uniformly enlarged, either one lobe or the other being swollen at times. The left lobe may be so enlarged that it is mistaken for the right lobe. The chills do not disappear later in the disease, but they often cease irregularly for a few days and then persist until death. The condition has shown a tendency to be chronic in some of my cases, and will persist for several weeks. The sensorium is not clouded, and the appetite may be ravenous, although there is marked and rapid emaciation. In many cases jaundice is present at some time, though it may be overlooked by the general practitioner, because he does not carefully search for it. A glance at the sclera will usually show slight jaundice, fleeting, and not lasting longer than a few days. Cases do occasionally recover, although rarely. Lymphangitis is often associated with portal phlebitis, but is also very often alone present. In portal phlebitis one will often find a large grouping of abscesses in one lobe or another, and I believe these cases are best treated by direct drainage through an abdominal incision, and not by aspiration. The abscesses feel like gummata, the liver being œdematous and boggy in their neighborhood. Another observation which is frequently overlooked is that subphrenic abscesses are apt to be secondary to the liver abscesses by direct extension, though they may also originate directly from the retroperitoneal lymphangitis.

Dr. Gerster. The few minutes I have I shall use to bring out what is really the most important part of my paper. In two of the

histories that are appended thereto phlebitis of the roots of the mesenteric vein was demonstrated. The condition was still a local one. After removing the appendix, search was made for thrombosed veins, and the thrombi were turned out. This is a process that should not be neglected. The parts should be exposed and thoroughly examined, which is easy to do, and much may be thus accomplished. The veins presenting themselves as hard, cylindrical masses are thrombosed. In the two cases above mentioned which presented this condition, and in which the characteristic chills were present, recovery took place. This is a part of the peritoneal toilet in appendicitis which deserves attention, and should be attended to whenever possible.

SINGLE ULCER OF THE URINARY BLADDER, NON-TUBERCULOUS AND NON-MALIGNANT, WITH REPORT OF CASES.

By GEORGE E. ARMSTRONG, M.D.,
MONTREAL, CANADA.

On October 14, 1902, a young man, aged twenty-one years, was transferred from the medical side to my ward in the Montreal General Hospital, complaining of pain in the end of the penis and frequency of micturition.

He had diphtheria when six years of age, followed by temporary paralysis of the vocal cords. He said that before the onset of the present illness he frequently suffered from severe pain in the lower abdominal region in the middle line. The pain came on about an hour after breakfast, and disappeared as soon as the bowels moved. This was a daily occurrence, but he thought little of it, and did not consult a physician. His habits were good, did not use alcohol in any form, smoked but little, and had no venereal history.

The present illness came on quite suddenly about August 8, 1902. He was in the best of health at the time. Three symptoms appeared almost simultaneously. These were: (1) pain at the end of the penis, about the corona, on the dorsum, just before micturition, and generally very severe, necessitating the administration of morphine; (2) frequency of micturition (he passed urine every twenty minutes or half-hour); when lying on his back the intervals were longer, and (3) loss of expulsive power—the urine just escaped and dropped down at his feet. The act of micturition was not accompanied by pain. He noticed nothing unusual about the urine; did not notice any blood.

He could give no reason for the occurrence of these symptoms.

He had no accident, had not suffered from violence in any form; had not been exposed to the weather more than any man who drove an express delivery wagon, and, as before remarked, had no venereal history.

On August 22, eight days after the onset of the symptoms, he consulted his family physician—a careful, accomplished, and painstaking man—who passed a steel sound. This did not cause much pain, and a few drops of blood followed.

Family history negative; father, mother, three brothers and two sisters alive and well. One brother died of diphtheria when a baby.

He was a fairly well-nourished young man of medium height, and weighed 123 pounds, 12 pounds less than when he first became ill. He complained almost constantly of severe pain at the end of the penis. If morphine were withheld his cries were so loud and frequent that all the other patients were disturbed. The urine was turbid and contained large quantities of thick, tenacious, mucopurulent matter. On standing, this material became very thick and viscid. The reaction was alkaline; the specific gravity could not be determined because of the thick mucopus. There were a few phosphates and triple phosphates and an abundance of pus cells, but no casts. For a fortnight I kept a couple of enthusiastic students at work examining the bacterial flora, their results being always checked by the hospital pathologist, Dr. McCrae.

Streptococci were always present in numbers, as well as small and large diplococci. The tubercle bacillus was never found.

He was losing weight. His temperature varied between 97° and 102° F. Under the influence of general anæsthesia I passed searchers into the bladder, with a negative result. The examination was followed by slight hemorrhage. Prolonged lavage failed to secure sufficient clearness of bladder contents to permit of the use of the cystoscope.

The physicians reported that there was no evidence of any intrathoracic disturbance. Outside the bladder nothing could be found to account for the temperature and emaciation.

I regarded the case as probably one of tuberculous cystitis, and decided to make a suprapubic incision, with the double object of

exploration for diagnostic purposes, and, if tuberculous ulceration were found, the establishment of permanent drainage for the relief of the pain, tenesmus, and septic absorption.

Bladder lavage, using solutions of boric acid, permanganate of potash, carbolic acid, silver nitrate and Thiersch's solution, had failed to afford any relief, and morphine was required to secure rest and sleep.

On November 25th, with the patient in the Trendelenburg position, I made the usual incision in the median line. I had only separated the muscles when the boric solution, which I had placed, so I supposed, in the bladder, began to flow out. The edges of the incision were retracted and the solution removed by swabs. By means of a strong reflected light I found that I had only opened the pro-peritoneal space or cavum Retzii. The bladder —small and contracted to about the size of a hen's egg—lay at the bottom of the space, with a large opening in its anterior wall the size of a twenty-five-cent piece. The edges of the opening were thick, rounded, and somewhat irregular in outline; the mucous membrane was everted. I could bring the internal orifice of the urethra, the openings of the ureters, and every part of the inner surface of the bladder into view, but no ulceration or other change could be detected. The space in front of the bladder measured five inches laterally and four inches anteroposteriorly. After careful cleansing a large-sized rubber tube was inserted through the suprapubic wound and down to the opening in the bladder wall.

The space lessened considerably in size for a time, but the temperature did not improve, and emaciation continued.

On January 20, 1903, I made a perineal puncture, and through this inserted a catheter into the bladder, with the view of securing dependent drainage. This has not proved to be altogether satisfactory, for while the greater part of the urine escapes by the perineum, there is also some overflow through the suprapubic wound, and the cavum Retzii is kept bathed with it.

About the middle of February he complained of pain in the left loin, and on March 13th I opened a perirenal abscess. The kidney was palpable, not much enlarged, firmly embedded in

adhesions, and the patient's condition was so bad that I did not deem it wise to explore further.

Unfortunately for the patient and for my argument, he died on April 24th. The autopsy showed acute miliary tuberculosis of both lungs, caseous tuberculosis of the bronchial glands, miliary tuberculosis of the left adrenal, spleen, kidneys, left ureter, and bladder.

My second case was a healthy school-boy, aged twelve years, with a good family history. He noticed blood in his urine on December 20, 1902. The hæmaturia persisted, and one week later he began to suffer pain at the end of the penis before and after micturition. The pain would pass off in about half an hour. At this time there was no marked frequency in urination. On January 17, 1903, he consulted his family physician for the pain, and it was found necessary to administer morphine.

I saw the boy in consultation on January 23d, and removed him to the Montreal General Hospital. The urine was turbid, acid, and contained blood, pus, and vesical epithelium. Two moderate-sized hyaline casts were found. There were also found diplococci and staphylococci.

On the following day, under ether anæsthesia, I introduced the cystoscope, and found on the anterior wall, about two inches behind the urethral orifice, a patch of ulceration as large as a ten-cent piece. A part of the circumference was abrupt, well defined, the remainder of the circumference gradually passing into healthy tissue. The base was dark, but not actually bleeding. Clear urine issued from the ureters. The bladder was then injected with a 1 per cent. solution of silver nitrate, and after an interval of two minutes this was withdrawn and the bladder injected with normal salt solution. This treatment of the bladder was repeated daily for seventeen days, when all symptoms had subsided.

During his stay in the hospital his temperature varied from 97° to 99° F., and his pulse from 72 to 96. He has remained perfectly well up to the present time.

In 1876 Bartlett[1] reported the death of a man, aged fifty-three years, from peritonitis secondary to intraperitoneal rupture of the bladder. At the autopsy there was found, exactly in the middle

line, on its posterior aspect, one inch from its apex and corresponding to the perforation, an ulcer which bore an exact resemblance to a chronic gastric ulcer: distinct loss of substance, as if a piece had been punched out, funnel-shaped, smooth edges; at one side was some puckering.

In 1885 Reeves[2] reported the death of a young woman from peritonitis secondary to perforation of the bladder. The perforation was through the base of a single ulcer. The perforation would seem to have been temporarily closed by omentum which separated during the removal of a urethral polypus.

In the same year Oliver[3] discusses the occurrence of a simple single ulcer of the urinary bladder similar to that occurring in the stomach and duodenum, but does not report cases.

In 1892 Wyeth[4] reported a case of intraperitoneal perforation of the bladder in a man, aged forty-three years. The perforation occurred through the base of an ulcer about the size of a half-dollar. The adjacent part of the bladder wall was dark colored. This patient passed a large amount of bloody urine four days before his death.

In 1896 Fenwick[5] reported six cases of "simple, solitary ulcer of the urinary bladder" in a clinical lecture published in the *British Medical Journal* of May 9, 1896. He has observed this ulcer in both sexes. The majority of his patients were young men aged about twenty years. He has observed contact ulcers on the opposite wall, especially in the female organ.

In 1892 Johnston[6] reported a case of death from peritonitis following a rupture of the bladder through the base of an apparently simple ulcer three inches in diameter.

In 1900 Chaufford[7] reported an intraperitoneal rupture, elliptical in shape and the size of a two-franc piece, occurring at the upper posterior part of the bladder, and noted its resemblance to a gastric ulcer.

Just a year ago Christopherson[8] reported a most interesting case of a man, aged forty-nine years, with symptoms of what he thought to be probably a tuberculous ulcer. These symptoms began about two years before, during an attack of rheumatism. They

were: frequency of micturition, pain during and after urination, suprapubic and at the end of the penis. He had suffered from lead colic. No tubercle could be found in any part of the urogenital tract or elsewhere, nor was the tubercle bacillus to be found in the urine. Had only passed sufficient blood to color the urine on one occasion. Through a suprapubic incision the cavity of the bladder was found to be small and the walls hypertrophied, but otherwise healthy, except for a small ragged irregular ulcer with granular surface and thin edges, and about 1.9 cm. in diameter, between the two ureters and on the posterior part of the trigone. When it was touched over with swabs of wool wet with carbolic acid (1 : 20) the surface bled readily. There were no signs of caseation or tubercles anywhere, and the ulcer looked more like an anal ulcer than anything else. The ulcer was not found indurated or perforating, and was quite unlike a gastric ulcer. There were no signs of malignant disease. The bladder was drained suprapubically and washed out with a solution of borax and iodine for twenty-eight days. In about two months he gained two stone in weight, and left the hospital apparently cured.

On January 7th of the present year Daly and Harrison[9] reported a case of spontaneous rupture of the bladder occurring in an Irish harvester, aged thirty-six years. The man was seized with pain while carrying a pail of water with which to wash himself. At the operation an intraperitoneal rent was discovered of sufficient size to admit the tip of the index finger. This was sutured with two layers of Lembert sutures, the mucous membrane not being included. The rent was situated midway between the fundus of the bladder and the bottom of Douglas' pouch, and was vertical and central. Notwithstanding some deplorable complications, the man made a good recovery.

Rawson[10] reports the death of a woman, aged thirty-five years, taken suddenly ill, and dying in thirty-six hours. At the autopsy a small ulcerated opening was found at the summit of the bladder. The mucous membrane of the bladder for the breadth of half an inch around the opening was highly injected with blood, and was of a much darker color than the rest of the mucous lining. Purulent

matter was adherent about the edges of the ulcer. The woman had been confined with a live child about a month previously by a midwife, and from what I could make out she had had a favorable labor, and attended to her usual work after the first week. She had never referred any pain to the region of the bladder, but had been heard to complain, both before and after labor, of an inability to empty her bladder completely.

Thurston[12] reports a case of chronic perforating ulcer of the bladder occurring in a married woman, aged fifty-two years. The symptoms had been present for over four years before the perforation of the fundus or the bladder occurred. The hole had been closed by adherent omentum.

We are all familiar with tuberculous ulceration of the bladder and with the breaking down of tissue secondary to neoplasms, and Proksch[11] has told us something of syphilitic ulceration, and it occurs rarely in cases of long-standing prostatic cystitis. Does there occur an ulceration of the bladder wall independently of trauma (including pressure), tubercle, syphilis, and new-growth? I am not prepared to answer that question in a monosyllable. The evidence that I have collected favors, in my opinion, an answer in the affirmative.

An ante-mortem diagnosis before the advent of the cystoscope was impossible, and the true condition was only determined after the occurrence of perforation, and then generally in the autopsy-room.

I have selected these seventeen cases from a larger number in which the reports were sometimes too incomplete to permit of classification. In some instances perforation has occurred after a fall or the receipt of some form of violence. It yet remains to be determined just how much force is needed to rupture a full or distended bladder, not weakened at any one point by ulceration or sacculation. In this list all such doubtful cases are excluded.

I think that we must look to one or more of three conditions for the cause of single ulcer of the bladder—infection, thrombosis, and syphilis. It has been thought by some that probably most perforating ulcers were due to a breaking-down gumma in the bladder

wall. In very few of the case-reports is the suspicion of syphilis raised, and the autopsy findings have not disclosed a condition that has suggested the presence of breaking-down gumma. In both of my cases cocci of various forms were present. The first may have been tuberculous in nature from the beginning, but at the time of first operation there was no appearance of tubercles. But it would appear that there must be some other etiological factor present in addition to the infection.

Simple infection of a normal bladder does not, as a rule, end in perforation. Mention is frequently made of the similarity between perforating ulcer of the bladder and that of the stomach and duodenum, and it is quite possible that in each case a similar pathology obtains.

The condition is referred to by Rokitansky under the name of chronic perforating ulcer of the bladder. Lawson Tait refers to four cases, in two of which Sir J. T. Simpson established a vesico-vaginal fistula to obtain physiological rest and relief to the patient from pain. The evidence of the exact nature of the bladder lesion in these cases is not made clear in the report.

The symptoms in the majority of cases were pain, frequency of micturition, and the presence of small quantities of blood in the urine.

The pain is very severe, and is often referred to some point in the penis in the male and about the neck of the bladder in the female. The intensity of the suffering is often very great. In both of my cases the penis was held in the hand and guarded from dreaded violence. These boys would cry out with the pain of the penis. Fenwick states that some of his patients would cut the pocket out of their trousers that they might carry the penis, and so better protect it. The suffering interferes with micturition, and requires morphine for its relief. In some cases there seems to have been very little pain indeed.

The frequency in micturition varies in different cases. My first case urinated very frequently. I think that I have found a definite relation to obtain between the locus of the ulcer and the pain and frequency of micturition. If the ulcer is about the trigone and

ureteral orifices, or, in fact, if it is in the neighborhood of the neck of the bladder, the pain and frequency are great. On the other hand, in those cases where the ulcer has been situated about the fundus there has often been a remarkable absence of symptoms until the occurrence of hemorrhage or perforation. The symptomatology in this respect bears a close resemblance to that of gastric ulcer.

The diagnosis can be made with a considerable degree of certainty when the onset is sudden and the symptoms mentioned are well defined. The cystoscope is of the greatest value here, and should always be used if possible.

The prognosis in cases seen early is good. They yield readily to treatment, and in some instances have probably healed without any treatment at all.

The local application of solutions of nitrate of silver seem to have been most generally useful. In my second case I used a solution of 1 : 10,000. It caused some smarting at first, which passed away soon after the solution was replaced by a saline solution. I used the injection daily, and the pain became progressively less as the patient improved. Sir James Simpson is reported to have treated two cases successfully by the establishment of a vesicovaginal fistula. Christopherson made a suprapubic incision, touched the ulcer over with swabs of wool wet with carbolic acid (1 : 20). The bladder was drained suprapubically and washed out with a solution of borax and iodine for twenty-eight days. In two months he gained two stone in weight. He left the hospital apparently cured. Boric acid, salol, urotropin, and helmitol are indicated.

It is unfortunate that an ulcer situated on the fundus is so often without striking symptoms. A hemorrhage may give the first intimation of its presence. If perforation occurs into the peritoneal cavity, it may be closed. I believe that as good results may be obtained here by early diagnosis and prompt interference as in the case of perforating ulcer in the stomach—perchance, even better results, because there may be a less virulent infection.

In conclusion I would submit that, in view of the clinical evi-

dence now accumulated of the existence of a single non-tuberculous ulcer of the urinary bladder, and the post-mortem reports of six perforations of the bladder through the bases of single non-tuberculous ulcers, the condition should be more generally recognized and find a place in our text-books.

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DISCUSSION.

Dr. William L. Estes, of South Bethlehem, Pa.

I would like to add another case to those reported in the paper. My patient was a man, aged fifty years. It was evidently a case of septic peritonitis. I had no idea, however, that the bladder was seriously involved until the abdomen was opened and the omentum, which was firmly adherent to the bladder, was separated. I found an ulcer about the size of a five-cent nickel coin; it was round in outline. Apparently it started from the mucous lining, and extended through the other layers of the bladder walls. It was located at the fundus. The edges were pared and the opening was sutured. The man made an uninterrupted recovery. The ulcer was not tuberculous, and it was not malignant.

SIMPLIFIED OPERATION FOR INTRACRANIAL RESECTION OF THE TRIGEMINAL IN INVETERATE NEURALGIAS.

By ROBERT ABBE, M.D.,
NEW YORK CITY.

Operations for the relief of inveterate neuralgia of the fifth nerve branches are more effectual in proportion to the depth at which the nerve trunk is resected.

Excision of the facial or maxillary portions gives relief from six months to one or two years, rarely longer. This has come to be regarded as not justifying the outlay of trouble and the facial scar, except in cases of aged or infirm patients, where the severity of intracranial operation at the Gasserian ganglion is not desirable.

Surgeons who have ventured to do the intracranial method recognize its greater value and the enduring cure that results. With this advantage, however, there is an attending risk, which depends on the hemorrhage—shock—incidental damage to the brain, and the risk of meningeal infection. None of these risks can be ignored, and all can be made less by modified methods.

The hemorrhage seems to differ in all cases, and it is not possible to predict that one may not have almost unmanageable bleeding in the separation of the dura and ganglion. Operators of the largest experience have occasionally had to prolong an operation two hours or more from delay in controlling hemorrhage, and have even packed the wound for forty-eight hours before returning to the excision of the ganglion and its branches.

This experience has led me to resort to ligature of the external carotid artery just above the thyroid, preliminary to opening the skull, in several recent cases. This adds but a few moments to the

procedure and prevents a large part of the arterial hemorrhage within the skull. The middle meningeal is the terminal branch of the external carotid artery, and recurrent anastomosis from below is not speedily very active after ligation.

The venous bleeding from which much trouble may always be anticipated is fortunately controlled by pressure and soon stops. My experience leads me to advise ligation of the external carotid in the neck in all cases of deep neurectomy at the beginning of operation. It seems to me to shorten the time of operation about one-half and render it comparatively dry.

Having minimized this one danger, we still face the three others mentioned, viz., shock, cerebral damage, and infective meningitis.

As shown by recent statistics, Lexer (*Arch. f. Chirurgie*, 1902, vol. lxv.) gives a résumé of 201 cases reported from all the literature of ganglion resection, and asserts that positively good results can only be obtained by complete removal of the Gasserian. Of 201 cases 33 died; 17 of these died at the close of operation (11 died of collapse without regaining consciousness); 7 died of meningitis; 2 had brain tumor, fatal; 1 softening of the temporal lobe; 2 postoperative pneumonia; 1 heart failure; 1 hemorrhage; 1 uræmic coma; 3 no cause of death reported.

In two brown softening of the cortex of the temporal lobe was found and œdema of the pia mater in one of these. Moreover, he says, in other fatal cases temporal lobe injuries were also found.

Every operator knows that the soft lobes of the brain will bear a moderate amount of handling without damage. They have to be lifted from the middle fossa to get access to the nerves which are deeply placed, and by gentle elevation they yield in an accommodating way that I confess has always been a surprise to me.

Up to a reasonable reduction of volume of the temporal lobes by pressure there seems to be no damage, and in a few hours subsequent to operation it may be presumed they are quite of their full size.

The damage that must surely happen to the cerebral substance when a sharp, flat-edged retractor is pressed against it by an ardent assistant, at varying angles and with constant recurrence of inden-

tations by its edges and point, during an hour or two of difficult operation, is clearly shown by the reported post-mortems.

There must be often a crushing force, not noticed by the operator perhaps, and not intended by the assistant.

The necessity of lifting these lobes of the brain and flattening them sufficiently to get access to the hidden ganglion makes a risk that one would gladly avoid.

Laceration of dura and brain, which is inevitable in ganglion removal, gives a good chance for the secondary abscesses and infection which have been reported.

The question of shock in this operation, which so large a proportion of the fatalities showed, will be attributed naturally in the mind of every surgeon to the three causes—hemorrhage, cerebral damage, and prolonged operation.

It has seemed to me that the limit of safe operative interference has been overstepped, and we should seek simplification if it be equally effectual.

Nearly seven years ago, after having operated many times by the intracranial method, either to avulse the branches from the ganglion or to dissect or curette its substance, I was brought to a stop by an unusually bloody case, after I had divided the branches at the foramina and torn a short piece out of the ganglion.

Fearing speedy reunion, I improvised a barrier of sterilized rubber tissue in front of the Gasserian and resting on the bone covering both foramina of exit. Primary union occurred and the patient has never had a twinge of pain during seven years.

This method I have resorted to since then in eight cases with success.

It has been questioned whether the rubber tissue is enduring, or if it may not become porous. To satisfy myself, I have made numerous experiments on rabbits. Several times I have placed a half-inch square of rubber tissue upon the brain of rabbits inside the dura or outside the dura, or outside the skull under the scalp. Again I placed an inch square on the surface of the liver, holding it by a silk stitch at each corner, and once again a similar piece outside the abdomen, but beneath the skin.

Its presence is borne well in any tissue. On the surface of the brain or between the dura and the skull, or outside the skull and under the scalp, it maintains its full shape and remains unchanged. During five months before the rabbits were killed the rubber laid on the surface of the brain without adhesions except at a portion of its margin. Adhesions held it tightly to the dura. When placed outside the dura and under the skull it was firmly held by both its surfaces and unchanged. The same when outside the skull and under the skin.

Inside or outside the abdomen, however, the motions of the viscera and soft parts allow the lymph investment to contract and encapsulate it, rolling it together so that it would have no value, though its substance was unaltered.

It stands proven then that, by practice, eight patients have retained the sterile rubber tissue for varying periods up to nearly seven years; that it has acted as a barrier to prevent recurrence of neuralgia; that experimentally it does not undergo porous degeneration; that between the dura and bone it is embedded in organized lymph, flat and in full size.

To secure these results it is essential that primary union be secured, inasmuch as the tissues would be expelled, like any foreign body, if once infected. Attempts to get cultures from rubber tissue cut out of packages obtained from any dealer show that it is entirely sterile, yet I rub it with bichloride and immerse it in salt solution just before operation.

The simplified operation which I offer for trial therefore is as follows:

Ligate the external carotid; make a straight incision in the temporal fossa above the zygoma; split the temporal muscle, scraping it widely from the bone, and enter the skull by a small trephine opening, rapidly enlarged by rongeurs to one and one-half inches diameter. Expose the second and third branches from the Gasserian ganglion to the foramina. Seize each at the foramen by a narrow clamp, cut it, and resect a half-inch or tear it from the ganglion; push back the dura well beyond the foramina; arrest bleeding by a moment's pressure, and spread over the bone a piece

of sterile rubber tissue, enough to more than cover both foramina, one inch wide by an inch and a half in length, which must be pressed upon the bone by a strip of gauze packed over it for a couple of minutes. When this is removed the rubber tissue lies in close contact with the skull and the dura is allowed to settle down in its place upon it. The wound is then closed by a few fine catgut sutures and drained for a day at its lower angle.

DISCUSSION.

Dr. George R. Fowler, of Brooklyn.

The technique of Dr. Abbe has simplified intracranial operative attacks very greatly. With reference to the prophylactic hæmostasis, some years ago I introduced the plan of ligating the external carotid preliminarily with the view of lessening the hemorrhage and thereby saving both time and loss of blood. In the first case thus operated upon the procedure seemed to fulfil my expectations, the patient making a good recovery. This experience was not repeated in a second case, however, and I have not given it a further trial. A year ago, in a case of intracranial neurectomy I employed the Abbe method of approach to the Gasserian ganglion, as well as the subdural implantation of rubber tissue to prevent reunion of the divided nerve ends. In this case I also employed Crile's method of temporary closure of the common carotids in order to maintain an operating field clear from blood. This latter indication appeared to be met by the procedure alluded to. In a second case in which the Crile plan of arresting the blood supply as furnished by the carotids to the head was tried there was considerable venous oozing during the operation, although this soon yielded to gentle pressure by packing with iodoform gauze, and patiently waiting. The bleeding in this case was probably due to the fact that the tape employed to constrict the carotid upon either side, and which was secured by an artery clamp, had dragged by the weight of the latter against the internal jugular vein, thereby preventing the return flow of blood through this channel. The case was one which Prof. Roswell Park kindly extended to me the courtesy of operating upon before the class at the Buffalo General Hospital, and we both agreed that the hemorrhage was quite as profuse as it would have been if no preliminary hæmostasis had been employed. The above explanation of the cause of the bleeding, which is probably the true one, was suggested by Dr. Maguire, Dr. Park's assistant.

Dr. George E. Brewer, of New York City.

About eighteen months ago I was confronted by a very severe hemorrhage, and after forty minutes of unsuccessful attempt I was about to abandon the operation. I followed out what has just been suggested by Dr. Abbe, but was able to devote only a few minutes to the finishing of the operation. After the division I introduced a layer of rubber tissue, and after a good deal of pressure the hemorrhage stopped sufficiently for me to complete the operation. The patient had had an intolerable neuralgia for some years, of which he was completely cured

and never has had any pain since. A second operation was done later simply from choice, seeing that such good results followed the first first operation. The operation was easily accomplished, and I kept track of the patient for three months afterward, at which time the relief still existed, but the subsequent history I do not know. As to the ligature of the external carotid, my experience has been that the hemorrhage is venous, and it is hard to control. In nearly every case it seems to be due to some tributary of the cavernous sinus. It has not seemed that external ligation would control the hemorrhage, although it would do so from a meningeal artery, which is usually easily controlled.

Dr. Abbe. As to the nature of the cases, seeing that the most inveterate ones have been cured, I was satisfied that the disease was not in the ganglion. If you remove a limited portion in front of the ganglion, you can form good, fibrous union, but nerve union will not follow. If you cut out two and a quarter inches, and will examine the nerve, you will find before it is handled at all that there will be, for about a quarter of an inch, spots of inflammation along the sheath. It seems to me that these are the original sites of the neuralgia, and from these the disease works back to the ganglion, even if not into it.

SMALL CONTRIBUTIONS TO THE SURGERY OF THE INTESTINAL TRACT.

1. CARDIOSPASM AND ITS TREATMENT. 2. PEPTIC ULCER OF THE JEJUNUM. 3. OPERATIVE TREATMENT OF SEVERE FORMS OF INVAGINATION OF THE INTESTINE. 4. OPERATION ON MALIGNANT GROWTHS OF THE LARGE INTESTINE.

By JOH. VON MIKULICZ, M.D., LL.D.,
BRESLAU, GERMANY.

When your President requested me to address your society on the subject of abdominal surgery I had originally intended to give the address a larger scope, as befitting your society. Unfortunately, I was unable to write up such a subject, owing to numerous demands made upon my time. Suffice it, therefore, to speak on some minor topics of intestinal surgery, and to apologize to you for the trivial character of the communications. Moreover, I cannot refer to the literature on the matter, nor—as I ought to—mention the authorities who have treated these lesions successfully.

1. ON CARDIOSPASM AND ITS TREATMENT.

The first subject on which I shall speak is the so-called "cardiospasm." You are well acquainted with a certain affection of the œsophagus which consists mainly of a sacculated or fusiform dilatation of the organ, most pronounced in the lowest portion of the œsophagus. Zenker, who first accurately described such cases, considered the lesion an idiopathic dilatation of the œsophagus. This disease occurs mainly during middle life, but has also been found in old age. It is characterized by a difficulty in swallowing either liquid or solid food, until in the advanced stage of the affection only very small amounts of food can reach the stomach. The

cause of this difficulty lies in the fact that the œsophagus retains a portion of the ingesta instead of being completely emptied during each act of swallowing, as is normal. In advanced stages this residue amounts to a quarter or even half a litre, and the patient finally dies of inanition.

Since I first began to examine the œsophagus with the œsophagoscope I have observed about twenty cases of this affection; during the last seven years alone I have taken careful notes on fourteen cases. Twenty years ago, when I made the first œsophagoscopical examinations, I showed that in all these cases there exists an abnormal occlusion of the cardiac orifice of the stomach which I consider due to a muscular spasm. I have therefore designated and described this affection under the name of "cardiospasm." While under normal conditions during the act of swallowing the cardiac orifice opens automatically, and easily admits the food into the stomach, it remains closed in case of cardiospasm, and this spasm must be overcome by the contraction of the muscular wall of the œsophagus. This leads to an excentric hypertrophy of the œsophageal wall, and the organ becomes more and more dilated as the free passage of the food is interfered with. Another consequence of this impeded passage of the food is a chronic œsophagitis, caused by the decomposition of the contents.

This affection can be definitely diagnosed in the living subject only by means of the œsophagoscope: without the œsophagoscopical examination the nature of the disease can only be surmised; in many cases carcinoma of the cardiac orifice of the stomach will be suspected. Also Roentgen rays can be of great value for the diagnosis of this affection. I should like to show you some photographs to prove this (demonstration). The affection which I have described is a primary cardiospasm if no other lesions are demonstrable. There is, however, a secondary cardiospasm which I have occasionally observed in cases of carcinoma of the cardiac end of the stomach. This secondary cardiospasm is originally entirely different from the secondary dilatation of the œsophagus in consequence of actual œsophageal carcinoma.

Two of the fourteen cases of primary cardiospasm were peculiar

in that they were followed by secondary carcinomata. In each case the carcinomatous growth was found in the first thoracic portion of the œsophagus, above the dilatation. One case was diagnosed by œsophagoscopical examination, the second at the autopsy. I wish to show you an illustration of the œsophagus in the latter case.

I refrain from discussing the etiology and the pathogenesis of the cardiospasm, because we are able only to surmise at present. I am convinced that we have to deal with an abnormal muscular contraction of the cardiac orifice. In regard to therapy, we were until recently able to do very little; regular washings of the œsophagus and removal of the decomposing residue can relieve only the secondary œsophagitis. In severe cases the patients must be fed with the tube; with very little practice the patient learns to pass the tube into the stomach. If this method is unsuccessful we must resort to a gastric fistula.

I have repeatedly attempted to dilate the contracted cardiac orifice, partly by passing fairly thick bougies, partly by inserting into the cardia a permanent canula supplied with a valve which allows liquids to pass into the stomach but prevents a backward flow.

Neither of these methods has proved particularly successful. I decided, therefore, to resort to heroic measures in the case of a female patient, aged twenty-three years, who was suffering intensely from the affection. The stomach was exposed by laparotomy, and an incision was made into the anterior wall wide enough to allow the entire left hand to pass into the stomach. Under the guidance of my fingers, which I pushed forward toward the cardiac end, I introduced an instrument resembling a glove stretcher into the cardiac orifice; the dilatation was gradually effected to such an extent that the blades of the instrument were about 7 cm. apart. Thus I caused a blunt dilatation of the cardia similar to the dilatation of the sphincter ani in case of anal fissure. Then I closed the wounds in the stomach and in the parietal walls. It was a complete success; a fortnight after the operation the patient partook of solid food. During a period of observation extending over three months

Ulcer of the jejunum following gastro-enterostomy because of congenital pylorus stenosis.

the patient was able to swallow every kind of food without any difficulty. She claimed never to have been in as good physical condition; her weight increased and her general appearance was much improved; and the œsophagoscopical examination has shown that the cardiac orifice is no longer tightly contracted, but opens normally during retching and swallowing.

The period of observation in this case is too short to draw a definite conclusion about the value of the operation which I have described to you—I performed the operation about four months ago. Considering the insufficiency of all therapeutic measures for this affection, I do not hesitate even now to advise the performance of this operation. Personally, I should not again make as large an incision into the wall of the stomach, but should prefer to introduce the dilator through a small gastric fistula; or one might construct an instrument which could be introduced into the cardia through the mouth, and act as a dilator.

2. ON PEPTIC ULCER OF THE JEJUNUM.

The second subject of which I shall briefly speak is the so-called peptic ulcer of the jejunum, an affection which, as you know, has only recently been observed by surgeons, and only as a sequel to gastroenterostomy. As far as I can gather from the accounts published by our German colleagues, about fifteen cases of this disease have been met with by Steinthal, Kocher, Heidenhain, Goepel, Kroenlein, Hahn, and myself; I have seen five cases of it. I do not know whether more cases of this disease have been observed in America, and I should be very much interested to hear what were the experiences of my American colleagues in the matter. In our experience peptic ulcer of the jejunum occurs only after gastroenterostomy performed for benign affections of the stomach, such as gastric ulcer or pyloric stenosis. Moreover, it appears only after anterior gastroenterostomy according to Woelfer's method; but it does not after von Hacker's posterior gastroenterostomy. It develops either during the first weeks after the operation or it may delay for several months. The general picture of the disease closely resembles that of gastric

ulcer; hence most cases were formerly regarded as a recurrence of the original trouble. Pain is a prominent symptom; it is very severe, and is increased by the ingestion of food. The ulcer lies either at the point of junction between the stomach and the jejunum—that is, at the artificial anastomosis—or it may be situated some centimetres—sometimes 10 cm.—away from the anastomosis. Since the wall of the jejunum is considerably thinner and less resistant than that of the stomach, serious complications are more apt to follow after jejunal ulcer than after gastric ulcer. These complications are: perforation into the abdominal cavity and death from subsequent peritonitis, or more frequently a gradual perforation through the anterior abdominal wall, usually at the site of the left rectus abdominalis—that is, a penetrating ulcer with inflammatory infiltration of the anterior abdominal wall; we have then the well-known pseudotumor which sometimes occurs with gastric ulcer, and which results from this inflammatory infiltration of the abdominal parietes. If the affection is recognized early, excision of the gut and suture may effect a cure; and this has been done in a few cases. However, there is a strong tendency to recurrence; in one of my own cases resection of the gut was followed by a new ulcer 10 cm. from the site of the first.

In most of these cases of jejunal ulcer there has been a marked hyperacidity of the gastric juice, but there are exceptions. Thus Kocher found in one case a diminished amount of hydrochloric acid and even a trace of lactic acid in the gastric juice. In this direction I have made an especially interesting observation in the case of an infant, aged three months. The patient suffered from congenital stenosis of the pylorus, accompanied by an immense hypertrophy of the pyloric muscle, as is usual in such cases. Two months after the operation there appeared multiple jejunal ulcers, which caused the death of the child through profuse intestinal hemorrhage and peritonitis. I show you here a picture of this last case. Since the stomach during infancy contains only a small amount of hydrochloric acid, and an examination of the contents of the stomach has proved this in my case, hyperacidity of the gastric juice could not be the cause of jejunal ulcer in this patient.

Nevertheless, we are pretty certain about the etiology of peptic ulcer of the jejunum; it can be explained only by the prolonged presence of gastric juice, which reaches the jejunum without having been normally diluted and neutralized by bile and by the pancreatic secretion. On a recent visit to the Johns Hopkins Hospital in Baltimore I had an opportunity of seeing a preparation which showed the formation of peptic ulcers in the jejunum of a dog after gastro-enterostomy. This occurred during the course of some experiments made by Dr. Stephen Watts, second assistant surgeon at that institution. An anterior or rather a ventral gastro-enterostomy was performed by suture without mechanical appliances. The dog died after three months. At the autopsy two ulcers were found in the jejunum opposite to the opening in the stomach. One of these had perforated and caused the death of the animal.

This shows the possibility of the formation of such ulcers in animals as well as in man.

All these observations, I believe, are very important in deciding upon the best and safest method of operating for gastric ulcer or pyloric stenosis. After these observations we are not entitled, in my opinion, to perform anterior gastro-enterostomy any longer—at least, not for benign affections of the stomach. For carcinomatous stenosis of the pylorus it may be considered, being technically the more simple operation. For the benign affections of the stomach we must choose an operation which does not expose the jejunum to the immediate action of the gastric juice—that is, an operation which restores, as far as possible, normal physiological conditions. The most rational method is the pyloroplastic operation, especially with Finney's modification. If this is not feasible we have to choose between gastroduodenostomy—which recently has been advocated by Kocher—and von Hacker's posterior gastroenterostomy.

3. ON OPERATIVE TREATMENT OF SEVERE FORMS OF INVAGINATION OF THE INTESTINE.

My third subject concerns the treatment of the severe forms of invagination of the intestine when disinvagination is impossible.

In such cases resection of the invaginated portion of the gut offers the only possibility of saving the patient. However, this method, as usually practised, is extremely dangerous, so that even the operation rarely restores the patient. Especially great is the danger of peritonitis. I have treated two cases in the following manner, which, in my opinion, offers the best chances for the patient's life; and, indeed, both cases made an uncomplicated recovery. The first case was that of a woman, aged twenty-seven years, the wife of a Polish merchant, who was admitted to the surgical clinic of Breslau in March, 1902, presenting the symptoms of intussusception. The patient had been sick for five weeks, presenting the characteristic symptoms of invagination, which had increased in severity up to the day of admission. Besides general meteorism, vomiting, and all other signs of intestinal obstruction, there had frequently been bloody stools. Inspection and palpation of the abdomen revealed a painful cylindrical tumor, about as thick as a man's arm, which began at about the middle of the transverse colon and ran toward the left side, corresponding in general to the direction of the descending colon, and went down into the pelvis. Examination of the anal region revealed a dark reddish-brown tumor of about the size of a fist, covered with intestinal mucosa, and protruding from the widely dilated anal orifice. Digital examination showed that this tumor was nothing but the lower end of the intussusceptum, extending into the rectum, and therefore connected with the tumor palpated through the abdominal wall. Further examination showed the prolapsed portion of intestine to be the cæcum with the ileocæcal valve, the lowest portion of which was already partly gangrenous. Thus we had here a case of ileocolic intussusception, the oral end of the large intestine being invaginated into the aboral portion down to the rectum, having dragged with it a portion of the ileum as an intussusceptum.

In view of the prolonged existence and the great extent of the invagination, as well as of the fact that part of the intussusceptum had become gangrenous, there could be no thought of reduction by manipulation. Resection alone could be considered. How-

ever, the ordinary operation of resection seemed too heroic a measure, considering the poor state of the patient (pulse 140). She seemed unable to withstand the risk of a peritoneal affection which is incurred with the ordinary method of intestinal resection. I therefore proceeded in the following manner, which almost completely excluded the danger of a postoperative peritonitis:

An incision 20 cm. long was made along the border of the left rectus abdominis. When the abdominal cavity was opened a small amount of a brownish-red, turbid exudation was found and evacuated; the descending colon, much stretched, congested, and presenting an œdematous infiltration, appeared in the opening. It was distended and showed numerous irregular transverse folds resulting from an axial dragging of the mesentery, which was invaginated along with the gut. The colon was drawn up into the wound, so as to expose freely a strip of its anterior wall, about 5 to 6 cm. wide. In this position it was stitched to the abdominal wall by a series of sutures through the serous covering, and thus the parietal layer of the peritoneum was united to the visceral layer; this completely excluded the exposed portion of the colon from the peritoneal cavity. In a few places where the sutures did not seem to be quite efficient to connect the two layers, owing to the transverse folds of the colon wall, small tampons of iodoform gauze were used to fill any remaining gaps.

The anterior wall of the colon, thus excluded from the peritoneal cavity, was opened by a longitudinal incision about 12 cm. in length. This incision exposed the intussusceptum, which at this point had not undergone any severe disturbances of circulation, but showed in many places ulcerations due to the pressure of the intussuscipiens. The intussusceptum thus exposed consisted of two tubes of intestine, one contained within the other, the outer being colon, the inner ileum. These tubes of intestine were in contact with each other on their serous surfaces.

Hence, if the invaginated gut were to be resected at this point, it became necessary to open also the peritoneal sac, which had been dragged into the intussusceptum. In order to avoid all danger of infection in this direction, I resected the invaginated gut in exact

accordance with the method which I had advised for the resection of simple prolapse of the rectum—that is, the outer and inner layers of the intussusceptum were cut away step by step, and a deep catgut suture was immediately put in to close the peritoneal pocket as soon as it was opened. The site of the operation was, meanwhile, continually flushed with a normal salt solution. Thus the gut was cut and sutured at once along its entire circumference, until the mesenteric attachment was reached. In separating the mesentery we resorted to multiple ligation. Here a small strip of iodoform gauze was inserted in order to drain the mesenteric pocket into the gut. After complete resection we had to extract the resected portion, which extended to the rectum. Attempts to do this from the rectum were unsuccessful, because the intussusceptum was too tightly held by the rectum and the sigmoid flexure. By slow and careful traction we succeeded in removing it through the abdominal wound. The intussusceptum was about 45 cm. long; it consisted of a double tube, the outer being colon, the inner ileum. So the length of the entire excised portion of intestine was about a metre.

The further procedure, as well as the course of the disease, presented nothing remarkable. The main cause for congratulation was the total absence of any peritonitis, so that recovery was uninterrupted. A large artificial anus had been made by the operation, through which all fecal matter was discharged. The artificial anus was closed about eight weeks later. The patient left the clinic cured.

The same method was used with equal success in the case of a second woman, aged thirty-five years.

4. ON OPERATION ON MALIGNANT GROWTHS OF THE LARGE INTESTINE.

In regard to the fourth topic I shall be brief, since I can refer to the paper which I read before the Congress of German Surgeons at Berlin a year ago. It deals with the operation for the removal of malignant tumors of the large intestine. Statistics collected until now show that the prevalent method of excision of the tumor

and immediate suture of the intestine gives very bad results, the mortality varying between 30 and 50 per cent., and most patients succumbing to peritonitis. The cause of this phenomenon is found, I believe, mainly in the secondary changes which take place in the intestinal walls under the influence of carcinomatous stenosis. The gut is dilated, its nutrition impaired, and its muscular wall is insufficient; consequently, after the operation we are apt to have complete atony of the intestine—the contents are arrested at the site of the suture, the suture yields, and peritonitis results. For this reason Bloch as early as 1892 advocated operating in selected cases in two sittings. Allingham and W. Edmounds also have divided the operation in special cases. For a number of years I have invariably performed the operation in two sittings, and have found that the results were infinitely better than formerly. Of twenty-four cases operated on, only four died after the operation; but in none of these cases can the method of procedure be held responsible for the fatal termination. One patient died, eleven days after the operation, of embolism of the lung; another, after a week, of pneumonia; a third, six weeks after the operation, of general carcinomatosis; and the fourth, within two days, of peritonitis, caused by rupture of the carcinomatous gut during the enucleation of the tumor, so that a large amount of infective intestinal contents reached the peritoneal cavity during the operation.

As regards the technique of the two operations performed by myself, I should like to say the following: The primary incision, the enucleation of the tumor, the removal of the lymphatic glands, —in short, the entire operation—is performed exactly as when one operation only is done. If now the tumor has been freed and completely enucleated, it is drawn out of the wound, the loop of gut is stitched to the parietal peritoneum with sutures including only the serous coat, and the abdominal wound is closed, leaving only room enough for the loop of the gut. Now only after the abdominal cavity is completely closed the tumor is excised, and an artificial anus is established, which is closed in two or four weeks, according to the usual methods. The disadvantage of this process is that the patient is afflicted for a few weeks with an artificial anus,

but I believe that this is fully balanced by the advantage of greater safety.

In closing I should like to say that, in my experience, the permanent results after operation for malignant tumor of the large intestine are very favorable—at least, more so than is generally supposed. I think we should strongly point out this fact to the physicians who are still very skeptical about this operation. In compiling the joint statistics of my clinic and that of Koerte, I find that among twenty-four cases which were under observation more than four years we have nine cases without any recurrence. Among these nine are several that have been under observation much more than four years. I operated on my first case seventeen years ago, while I still conducted the clinic at Krakow.

THE SURGERY OF THE SIMPLE DISEASES OF THE STOMACH.

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May I be permitted at the outset of my paper to express my most cordial thanks to the Fellows of the American Surgical Association for the signal honor which has been conferred upon me in asking me to present a paper at this meeting? There are few incidents so grateful to a surgeon—there can be none more encouraging—than a recognition from those best qualified to judge of the work which he is striving to do. My earnest hope is that my contribution to your proceedings may, in some small measure, repay you for the great courtesy which you thave shown to me to-day.

I propose to deal in my paper with the surgery of the simple—that is, the non-malignant—diseases of the stomach. The subject, I am well aware, is one that has been debated at previous meetings of this Association; but you will, I think, agree that there is still much that has to be learned—there is still much that may engage us in profitable discussion; and I do not think, therefore, that any apology is needed for this choice of a subject.

The great majority of the simple diseases of the stomach which can be successfully treated by surgical measures are due to ulceration or to its complications and results. These various conditions can be dealt with in the following order: (1) perforation of gastric or duodenal ulcers; (2) hemorrhage from gastric or duodenal ulcers; (3) chronic ulcer, its various clinical types; (4) hour-glass stomach.

Perforation of Gastric or Duodenal Ulcers. The perforation of gastric or duodenal ulcer is one of the most serious and most overwhelming catastrophes that can befall a human being. The onset of the symptoms is sudden, the course rapid, and, unless surgical measures are adopted early, the disease hastens to fatal ending in almost every instance. Perforation of the stomach is usually described as being of two varieties—*acute* and *chronic;* but there is an intermediate class of cases, not embraced by either of these terms, which is best described as *subacute.*

In acute perforation the ulcer gives way suddenly and completely. A larger or smaller hole results, and through this the stomach contents are free to escape at once into the general cavity of the peritoneum.

In subacute perforation the ulcer probably gives way almost as quickly as in the acute form, but owing to the small size of the ulcer, or to the emptiness of the stomach, or to the instant plugging of the opening by an omental flap or tag, or to the speedy formation of lymph which forms, as it were, a cork or lid for the ulcer, the escape of fluid from the stomach is small in quantity and the damage inflicted thereby is less considerable. The symptoms at their onset may be as grave as those in acute perforation, but on opening the abdomen the ulcer may be seen to be sealed over.

In the subacute form of perforation I have found that there is always a complaint of greater discomfort for several days preceding the rupture. Vague general or localized pains have been felt in the abdomen, or a sharp spasm or "stitch" when the patient turned quickly or attempted to laugh. One girl, a housemaid, felt the pain down her left side, especially when reaching up to her work; another said it hurt her to bend, as her side felt stiff. These premonitory symptoms are important, and, if recognized, they should enable us to take measures to prevent the occurrence of perforation. They doubtless have their origin in a localized peritonitis, and the stiffness is due to the unconscious protection of an inflamed area by a muscular splint.

In chronic perforation the ulcer has slowly eaten its way through the stomach coats, and a protective peritonitis has had time to

develop at the base. The escape of stomach contents is, therefore, local merely; barriers of lymph confine the fluid to a restricted area, and perigastric abscess forms. A chronic perforation occurs more frequently on the posterior surface of the stomach, and the perigastric abscess occasioned thereby is recognized as "subphrenic." The acute and subacute forms of perforating ulcer are more common on the anterior surface.

There can be no doubt that recovery by medical treatment alone is possible both in the acute and in the subacute forms of perforation. I have had two cases under my care in which a diagnosis of perforation had been made by competent medical men. In both an operation was impossible, as no skilled help was available until the urgency of the symptoms seemed to have passed off. When I operated, many months later, the evidence of peritonitis completely surrounding the stomach was undeniable. Though patients may recover, their recovery cannot be urged as a reason for the delay or withholding of surgical help in all cases, for the possibility of spontaneous recovery, though not denied, is yet so remote as to make it imperative to adopt operative treatment at the earliest possible moment. The risk of operation is definite, the hazard of delay is immeasurable. There are times when the diagnosis may be difficult. If morphine has been administered to still the intolerable pain, the patient's condition becomes placid and comfortable. It may be almost impossible then to recognize the extreme urgency of the case. In such circumstances I have, however, placed great reliance upon a continued hardness and rigidity of the abdominal muscles. Even when the patient expresses herself as free from pain, when the aspect has become natural, and when the pulse has returned to the normal, the abdominal rigidity remains. In the case of I. S., a girl, aged seventeen years, upon whom I operated for a perforated duodenal ulcer, the medical man who sent her to the infirmary had diagnosed a perforated gastric ulcer, and had told the patient and her parents that immediate operation alone could save her life. Having obtained consent to operation, he despatched the girl to the infirmary, and gave a hypodermic injection of $\frac{1}{4}$ gr. morphine to lessen the dis-

tress of the journey. When I saw her shortly after her arrival, she looked in perfect health, she had no suffering, and her pulse and respirations were normal. The abdomen, though not distended, was absolutely rigid and immobile, and I did not hesitate to operate at once. In any uncertain case I should incline to operation rather than to indefinite postponement to solve the diagnosis.

I have seen a difficulty in diagnosis arise, and I know of three cases in which negative exploration has been performed, when the patient was a woman, at the commencement of a menstrual period. From some unexplained and indeterminate cause a sharp attack of abdominal pain, followed by vomiting, distention, prostration, and collapse had occurred in all, and had caused a confusion in the diagnosis. In the case under my own observation a history of previous similar, though less severe, attacks at the menstrual epoch, and the absence of any marked abdominal stiffness or tenderness, though the belly was obviously distended, enabled me to negative the question of perforating ulcer of the stomach.

The operation should be conducted speedily, and all means adopted to save the patient from shock. The excision of the ulcer is not necessary. My practice is to close the ulcer at once by a single catgut suture taken through from side to side, so as to prevent any further leakage during the application of the sutures. I apply two continuous sutures of Pagenstecher thread, which infold the ulcer and a portion of healthy stomach around it. After the stitches are completed the cleansing of the peritoneum is begun. If there is much soiling, a free flushing of the cavity is necessary; if the operation is done within ten to twelve hours, a gentle wiping of the surrounding area with wet swabs will suffice. Drainage, as a rule, is not necessary, except in the very late cases; but when adopted it should be free and, if necessary, a second suprapubic incision should be made. I have preferred the enlarging of the original incision and free flushing through that to the method of multiple incisions advocated by Finney. One point I think requires emphasis: it is the multiplicity of perforating ulcers. As soon as the ulcer first discovered is sutured, a rapid

survey of the whole stomach is desirable, in order that any other ulcer may be laid bare. An examination of a large number of recorded cases has shown that double perforation occurs in no less than 20 per cent. In the majority the second ulcer was on the posterior surface, at a point exactly opposed to the first. In duodenal ulceration the perforation may be very large; the ulcer seems to have fallen out bodily. When the gap is stitched up a narrowing of the calibre of the duodenum results, and it may, therefore, be necessary to give an alternative route from the stomach by performing gastroenterostomy.

Hemorrhage. The bleeding from gastric or duodenal ulcers is recognizable either as hæmatemesis or melæna. In lesser degree these symptoms are seen not infrequently; in their severer forms they are of dire significance, and may be the sole cause of the patient's death. It is but rarely that the surgeon is called upon for so momentous a judgment as is necessary in cases of severe hæmatemesis or severe melæna, for the condition of the patient is poor—even, at times, desperate. Operative intervention is, therefore, hazardous; yet a continued bleeding will, in certain cases, inevitably end in death.

It is necessary at the outset to emphasize the fact—a fact frequently ignored—that hemorrhage may manifest itself under entirely different circumstances in different patients. In some it is the earliest and for a time the only symptom of gastric disturbance; in others it is the last expression in a long and tedious course of symptoms. In other words, the hemorrhage may occur from an *acute* or from a *chronic ulcer* of the stomach or duodenum. It will be found, when the clinical history of a series of cases is examined, that, whereas in the latter the bleeding varies within the widest limits both as regards quantity and frequency, in the former the clinical history is repeated in case after case in a most remarkable manner.

Hemorrhage from an Acute Ulcer. Under the term *acute ulcer* of the stomach are probably included several varieties of pathological conditions which are different in causation, different in destiny, but alike in the single fact that their clinical recognition

is due to the bleeding which occurs from them in abundant quantity. There is the ordinary peptic ulcer; there is the minute erosion, barely recognizable even on close scrutiny, which yet opens up a vessel; and there are "weeping patches" and "villous areas" and similar indeterminate and unnumbered conditions which have been recognized when the stomach has been explored during life. To the clinician all these conditions are betrayed by their tendency to hemorrhage.

In almost every instance the hemorrhage is the first symptom. Even on close inquiry it is difficult to elicit any history of antecedent gastric discomforts. The vomiting of blood comes unexpectedly and suddenly, a large quantity of blood is lost, and the patient suffers—often in an extreme degree—from the symptoms of hemorrhage. The pulse becomes feeble and fluttering, the face waxen, the breathing rapid and shallow, the body surface cold or clammy. For a time the symptoms may give rise to serious alarm, but a rally is seldom long delayed. The bleeding is checked spontaneously, and vomiting is rarely repeated, or, if repeated, the quantity of blood lost is but small.

In several of my cases a sudden, apparently causeless, hemorrhage has ushered in a long train of symptoms of dyspepsia. The acute ulcer has been the precursor, or, rather, the earliest stage, of a chronic ulcer.

The characteristics of hemorrhage from an acute gastric ulcer are, therefore: *spontaneity, abruptness of onset, the rapid loss of a large quantity of blood, the marked tendency to spontaneous cessation, the infrequency of a repetition of the hemorrhage in anything but trivial quantity, and the transience of the resulting anæmia.*

Hemorrhage from a Chronic Ulcer. The bleeding from a chronic ulcer of the stomach or duodenum may vary within the widest limits both of frequency and of quantity. For convenience of description I should arrange the cases in four groups:

1. In the first the hemorrhages are latent or concealed. The blood is small in quantity, and may be recognized only after minute examination of the stomach contents or of the feces. The estimates given by various writers as to the occurrence of hemorrage in

ulcer vary between 20 and 80 per cent., and we are entitled to assume that this wide divergence of statement is due not so much to differences in the symptoms of ulcer, but, rather, to the varying degrees of closeness with which the cases are observed, and to differences in the frequency and minuteness of examinations of the stomach contents and the feces. It would probably not be rash to assume that all s of the sulcertomach or duodenum bleed at some time or other; but if the bleeding be trivial and infrequently repeated, it is never likely to obtain clinical recognition.

2. In the second group those cases should be included which are characterized by intermittent hemorrhage. The bleeding is copious but transient, and occurs at intervals of two, three, or more months. An exemplary instance of this class is the following:

A. S., female, aged twenty-eight years. In May, 1898, the patient had a sudden attack of profuse bleeding from the stomach. She was in bed six weeks. For eighteen months after this her health was very poor, indigestion was constant, vomiting was occasional, constipation was invariable. For six months following she was in fairly good health, and was able to take food much better. In April, 1900, indigestion became severe, and a copious hemorrhage again occurred. Treatment was continued for six months with much benefit. In January, 1902, a third attack of hæmatemesis and fainting; after this she was kept in bed for four weeks. In September, 1902, again hæmatemesis, as severe as before. From then to January, 1903, she was under constant treatment, but improvement was very slow. Anæmia has been a prominent symptom since April, 1900. At the operation a large ulcer was found in the stomach, and a second in the duodenum. Gastro-enterostomy was successfully performed.

In all the cases in this group indigestion is a prominent symptom. The hemorrhage often occurs without cause, but at times there may have been noticed an exacerbation of gastric discomfort and uneasiness for a few days. Anæmia is almost constant.

3. In the third group the cases are characterized by hemorrhages, which are rapidly repeated, and on all occasions abundant. In the majority of patients the symptoms of indigestion which

have been noticed for months or years before have undergone an appreciable increase in the recent days. Then suddenly the hemorrhage occurs, a large quantity—a pint or a pint and a half—of blood is vomited. The patient may faint from loss of blood; he shows always the general symptoms of bleeding. For twelve or twenty-four hours the vomiting ceases, to reappear at the end of this time, without apparent cause, and in equal or greater quantity. A second latent period is followed by a further hemorrhage, and so the patient becomes in a condition of the greatest peril.

No better example of this class could be cited than the following: M. W., female, aged twenty-four years. Has suffered from symptoms of gastric ulcer, pain, vomiting, and inability to take solid food for fifteen months. Eleven weeks before admission to hospital all her symptoms became worse. Vomiting became frequent; pain was almost intolerable. During the five weeks before admission she vomited daily, and on almost all occasions some blood came. While waiting in the hospital she vomited three times in five days, and on each occasion about half a pint of blood came. She was very blanched. Pulse 112. The motions were tarry on two occasions. At the operation two old scars and one showing recent inflammation were seen. Gastroenterostomy led to perfect recovery.

4. The fourth group would comprise those cases in which the hemorrhage occurs in enormous quantity, inundating the patient and leading to almost instant death. The opening of a splenic artery, the aorta, the vena cava, or the pancreaticoduodenal vessels, allows of the so rapid escape of blood that the patient dies as surely and as swiftly as if his carotid or femoral vessels were divided. Such cases, fortunately, are rare. In my own experience only one such example has occurred; a large oval opening being then found in the splenic artery.

If, then, we accept the classification of cases of hemorrhage from gastric or duodenal ulcer into the four groups suggested, we may define their characteristics as follows:

1. The hemorrhage is latent or concealed, is always trivial and often inconspicuous.

2. The hemorrhage is intermittent, but in moderate quantity, occurring spontaneously and with apparent caprice at infrequent intervals. The life of the patient is never in jeopardy from loss of blood, though anæmia is a persisting symptom.

3. The hemorrhage occurs generally, but not always, after a warning exacerbation of chronic symptoms. It is rapidly repeated, is always abundant, its persistence and excess cause grave peril, and will, if unchecked, be the determining cause of the patient's death.

4. The hemorrhage is instant, overwhelming, and lethal.

The Treatment of Hemorrhage. (*a*) *From an Acute Ulcer:* If what has been said of the characteristics of hemorrhage from an acute ulcer prove to be true, it is clear that the aid of the surgeon will rarely need to be invoked. Medical means alone will suffice in almost every instance to ensure the recovery of the patient. Though the hemorrhage is alarming from its suddenness and intensity, it may confidently be predicted that, in the majority of cases, it will not recur; or that, if it recur, the quantity lost will almost certainly be small.

There are, however, a few cases in which the hemorrhage may be both copious and recurring, and may threaten the life of the patient. Under such circumstances an operation may be required. An examination of the recorded cases has convinced me that, wherever surgical treatment is deemed advisable, gastroenterostomy, speedily performed, will prove the surest means of leading to the arrest of the bleeding. In not a few records one reads that the whole surface of the mucosa seemed to be "weeping blood," that multiple points of oozing appeared scattered irregularly over the stomach wall, or that a definite source of the blood—any point from which the blood chiefly ran—could not be ascertained. The surgeon has then fallen back upon styptics or the cautery, or the ligaturing of a villous patch in mass. It is difficult to convince one's self that any of these procedures has had the smallest effect for good; and in some the bleeding has recurred after the operation, and has determined the fatal issue. A search for a bleeding point is futile, harmful, and, in my judgment, quite unnecessary.

The performance of gastroenterostomy will prove more effective than any other procedure, both in checking the hemorrhage and in preventing its recurrence.

(*b*) *From a Chronic Ulcer:* It is mainly in regard to the cases included in Group 3 of the classification given above that the question of surgical treatment will arise. If we picture to ourselves the pathological conditions present in such a case, it will be seen that, though the bleeding may be spontaneously checked for a time, it will show a marked tendency to recur. The base of the ulcer is, as a rule, densely hard, and the vessel traverses it like a rigid pipe. The vessel is eaten into, as it were, by the ulcer, which erodes one side, leaving a ragged hole. Owing to the stiffening by chronic inflammatory deposit, the artery is unable to contract or retract, and the bleeding can, therefore, only be checked by the plugging of the opening by a thrombus. That such a plugging does occur there can be no doubt, for in one case I have seen it during life; on gently detaching the clot the bleeding began at once with furious onset. The tendency, indeed, even in a chronic ulcer such as I have depicted, must be to spontaneous cessation, for in no other way can the stopping and recurrence of bleeding (constantly seen) be explained. There is some condition, as yet uncertain, which is responsible for the detaching of the plug. This condition, I venture to think, is distention of the stomach, whereby the base of the ulcer is stretched and the clot disturbed; for my record of cases shows indisputably that a gastroenterostomy performed upon a patient suffering from this form of bleeding suffices to check the tendency to further hemorrhage, and permits of the speedy healing of the ulcer. In all patients so suffering a prolonged search for the ulcer in the stomach is injudicious, and the ulcer when found may, as the result of firm fusion with an adjacent structure, be irremovable. In two cases I have excised the ulcer. In the first the ulcer was on the posterior surface of the stomach, and to the opening left by its removal I anastomosed a loop of the jejunum; in the second the ulcer lay on the anterior surface near the lesser curvature toward the cardia. In this I did not perform gastroenterostomy. In all the other cases that I

have operated upon I have not attempted to deal directly with the ulcer, but have hastened to perform gastroenterostomy. Of all the patients the one upon whom I did not perform a gastroenterostomy was the only one I lost; the others recovered speedily and without further sign of hemorrhage.

In some cases an examination of the stomach may reveal two chronic ulcers or more, from each one of which the blood may be coming. To deal with each would be inadvisable or impossible. Cases, moreover, are recorded in which after an ulcer had been excised or ligatured in mass the bleeding had recurred and proved fatal.

In all cases, therefore, of hemorrhage from a chronic ulcer, an operation should be performed at the earliest possible moment. Search for and local treatment of the ulcer or ulcers are not necessary. A gastroenterostomy will, without doubt, prevent a recurrence of hemorrhage and lead to rapid healing of the ulcer from which the blood has come.

The suggestion of Dr. W. L. Rodman that the ulcer-bearing area of the stomach should be removed by partial gastrectomy is one that merits, and will doubtless receive, the careful and favorable consideration of surgeons.

Chronic Ulcer. Chronic ulcer of the stomach may present itself clinically in a great diversity of form. In some the onset is brusque —a copious hemorrhage from an acute ulcer being the first manifestation of gastric disease. After the lapse of a few days or weeks, however, gastralgia, vomiting, and other symptoms appear, and the chronic ulcer is established. In others the onset is latent and the early symptoms subdued. A patient may say that for several months a trivial, vague uneasiness has been experienced that would have been forgotten but for the later accession of severe symptoms. In still others the course of the disease may present very remarkable intermissions. For several weeks the symptoms may be most marked and disabling, hemorrhage may occur on one or more occasions, but gradually an improvement is observed, and, after a time, all the distress may rapidly subside, leaving the patient in good health. The appetite may be restored, and the

body weight may increase by a stone or even more. After a few months' interval a recurrence of the symptoms is observed, all the details of the former illness are repeated, and fresh hemorrhage may occur. And so the history may be repeated. In these circumstances the symptoms are due, perhaps, to the breaking down in the scar of a solitary ulcer or to the fresh outbreak of ulcerated patches in other parts of the organ. Of the two possibilities the former is probably the more frequent.

I have no doubt that many patients who have died from supposed malignant disease of the stomach have suffered from nothing but chronic ulceration. The induration which a persisting ulceration may cause is remarkable both for its extent and for its extraordinary mimicry of the appearances of malignant disease. In some of my own cases, and especially in one case of hour-glass stomach, the mass of inflammatory tissue was, with the knowledge I then possessed, absolutely indistinguishable by inspection and palpation from a malignant growth. Recently, however, I have in doubtful cases been able, I think, to distinguish chronic inflammatory masses by their perfect smoothness of surface. A malignant growth is always irregular, knotted, nodular, or "gritty" on the surface; an inflammatory mass is more smoothly rounded off, and there is often a milky opacity of the peritoneum. The frequency with which carcinoma will develop in chronic ulcer is now generally acknowledged. Hauser estimates the frequency at 6 per cent., a proportion which seems to me to be in excess of the truth. In my own experience only one case has been recognized.

The pathological conditions caused by chronic ulceration in the stomach are of great variety. When marked cicatricial contraction occurs the viscus is narrowed at the site of the ulcer, and an hour-glass stomach, or a trifid stomach, or a dilated stomach due to pyloric or duodenal stenosis, results. If the ulcer slowly deepens, a perigastritis is produced, and the stomach may become ankylosed to the abdominal wall, or the pancreas, or the liver, or any other neighboring structure. In all these conditions, and in others where no warping of the stomach can be found, an inveterate dyspepsia is a common symptom.

It has been the immemorial custom to look upon dyspepsia as due chiefly, if not solely, to deficiency in the quantity or quality of the gastric juice, to some lack of adequate power in the stomach as a secreting organ. But dyspepsia of the intractable, constantly recurring form is more often a matter of physics than of chemistry. In several cases, as my records will show, I have operated for no other symptom than intolerable dyspepsia, when no diagnosis of pyloric obstruction, hour-glass stomach, or other mechanical deviation from the normal could be made. Yet at the operation abundant proof has been obtained that there was obvious distortion or puckering or adhesion at one part or another of the organ, and that the stomach was crippled in the freedom of its action by these after-effects of ulceration. One observation I have repeatedly made in operating upon cases of chronic gastric and duodenal ulcers is that such ulcers are often multiple. If a well-marked ulcer is found at, say, the pyloric end of the stomach on the anterior surface, a second ulcer may be found perhaps at an exactly apposing point in the posterior surface, perhaps elsewhere in the stomach. Chronic gastric ulcers are, in my experience, rarely solitary.

The indications for operation in chronic ulcer of the stomach are of widely different character. When the ulcer is near the pylorus a dilated stomach will probably be the chief clinical sign; when the ulcer is in the body an hour-glass stomach may be caused; when the ulcer is nearer the cardiac end gastralgia and dyspepsia may be the only indications.

The evidences of old ulceration in the stomach are at times difficult to discover. A thin fibrous adhesion, a little crumpling of the surface, or a whitish blot on the serous coat may be all that is left of a patch of ulceration. When the stomach is pinched up between the fingers a little local thickening may be felt, or the mucous membrane may not, as it should, roll away from the muscular coat on gentle pressure. If in performing gastro-enterostomy the needle has to be passed through the stomach wall at the margin of an old ulcer, the different and greatly-increased resistance to its passage is ample evidence of the change

that has taken place. Inveterate dyspepsia is in itself an ample warrant for surgical treatment. Cases are within the experience of all in which prolonged medical treatment, most thoroughly and carefully supervised, proves ineffective, or, if temporarily beneficial, is powerless to ward off the recurrence of dyspepsia. In such cases, be the physical signs what they may, an operation is desirable, and in my experience abundant justification for it will almost always be found when the stomach comes to be examined.

There are few beings so abjectly miserable as those who are the victims of intractable dyspepsia. The meal-time, which should be a delight, is a time of despair and foreboding. The keen relish of good food, which the man in physical health should appreciate, is a joy unknown or long forgotten to the dyspeptic. A patient who has misery written in every wrinkle of a thin and haggard face, who, by reason of long suffering and bitter experience, has felt compelled to abandon first one dish and then another, until fluids alone can be taken, and these not always with impunity—a patient, to say the truth, whose whole life becomes embittered by the pangs of a suffering which he must inflict upon himself—this patient will find, if a gastroenterostomy be done for the chronic ulcer, which is the source of all his trouble, that his return to health and appetite is at first almost beyond belief.

Not a few of the patients upon whom I have operated have almost declined at the first to take the solid food—vegetables, puddings, pastry, and so forth—that I have ordered them. And when the meal has been taken haltingly, and with grave doubt, a genuine surprise is expressed that no disablement has followed. Indeed, I do not know any operation in surgery which gives better results, which gives more complete satisfaction both to the patient and to his surgeon than gastroenterostomy for chronic ulcer of the stomach.

Operative Treatment. In operating upon chronic ulcer of the stomach I always perform gastroenterostomy. It matters not where the ulcer is placed, a gastroenterostomy will relieve the symptoms completely and permanently, and will permit of the

sound healing of the ulcer. This fact, I submit, is placed beyond dispute by the series of cases I am able to record.

At first sight it might appear desirable on all occasions or at all times when possible to excise the ulcer. Such a course is entirely unnecessary; moreover, it is futile. For I have already pointed out that gastric ulcer is rarely solitary. If, therefore, two ulcers are found, or more than two, it is not always possible to say, even by close examination, which of the two is chiefly at fault. To excise all the ulcers—for I have seen a stomach so scarred that the ulcers seemed universal—is quite out of the question unless a partial gastrectomy is performed. But if the chief offending ulcer be excised, gastroenterostomy would still, in my judgment, be necessary, for among the cases of excision of ulcer which are recorded there is not infrequent mention of little or no permanent improvement. In all cases, therefore, I submit gastroenterostomy and gastroenterostomy alone should be performed. Excision is unnecessary, often impossible, always insufficient, and is, therefore, not to be commended.

On three occasions I have performed pyloroplasty. The operation is one which, both from its ingenuity and its immediate success, appeals strongly to the surgeon. It is, however, unreliable, a return of the symptoms being not seldom observed. Of my three patients one remains perfectly well, the second is better, but is certainly not in such good health as the average case of gastroenterostomy; the third showed a speedy return of all the symptoms, and I then performed gastro-enterostomy with a perfectly satisfactory result. In this last case, and in others which I have seen, the return of the symptoms seemed to be due in part to a narrowing at the site of the pyloroplasty and in part to the formation of widespread and tough adhesions around the pyloric portion of the stomach, adhesions which must have seriously hampered the stomach in its freedom of action. Pyloroplasty is, in my judgment, an uncertain operation, and its results cannot compare with those seen after the operation of gastroenterostomy.

In the performance of gastroenterostomy I have made the anastomosis on the anterior and on the posterior surface, and I

have used the Murphy button and Laplace's forceps as aids to the operation. I wish to speak gratefully of the help I have received from these instruments, but the greatest service they have rendered me is to convince me that they are entirely unnecessary. No better anastomosis is possible than that made with the simple suture, none so adaptable, and, so far as speed is concerned, I am content to abide the decision of the time-keeper. With the simple suture a gastroenterostomy rarely takes, from the beginning of the incision to the last stitch, more than thirty minutes, and I have once completed the operation in seventeen minutes. I mention these times because I think the question of pace important. Speed is essential, haste is often disastrous; the two should be distinguished. Speed should be the achievement, not the aim, of an operator. His work must be thoroughly done, but being so done, then the quicker it is done the better. I maintain that no time is saved by any mechanical appliance, and the operation is, with their aid, less perfect than it should be. I know the view which is held in America as to the worth of the Murphy button, and I have nothing but praise for the great ingenuity displayed in its making. But not the most ardent partisan will say that the Murphy button *never* courts disaster. I have seen two patients operated upon for intestinal obstruction caused by a Murphy button used for gastroenterostomy—in one case the button had remained for six years. I have myself lost one patient, three weeks after the operation, from perforation of a button used in the performance of ileosigmoidostomy. Now, by the method of suture which I adopt for all forms of intestinal and gastric anastomoses there is no possibility—I speak positively—of present failure or of future mechanical disaster. The suture line has not leaked in one of my cases; the anastomosis is perfection. In one case of ileosigmoidostomy, performed in acute obstruction due to cancer in the splenic flexure, the patient died at the end of twenty-three and a half hours. The anastomotic line was closed with the most minute perfection. I claim for the method that it is simple, speedy, applicable to all forms of anastomosis (and, therefore, time-saving in each, for the operator is quicker in a method he knows well),

and is not open to the objection that future troubles are at least possible.

The following are the steps of the operation of gastroenterostomy: The abdomen is opened to the right of the middle line, and the fibres of the rectus are split. On opening the peritoneum a complete examination of the whole stomach and duodenum is made. The importance of this cannot be overemphasized. A constriction in the body or toward the cardiac end may be most readily overlooked when, as is not uncommonly the case, a marked constriction at the pylorus, seen at once, is ample to account for all the symptoms. Cases of hour-glass stomach which have been overlooked at the operation, and a futile anastomosis made between the pyloric pouch and the jejunum, are recorded by several distinguished operators, and the mistake is an easy one to make unless one is determined to examine the whole of the stomach in every case. The importance of this examination of the whole stomach has recently received additional emphasis from the observation of a case upon which I operated a few months ago. I had diagnosed hour-glass stomach, and on opening the abdomen a perfect bilocular stomach at once was exposed. After demonstrating this I remarked that I always liked to see quite up to the cardiac before beginning my operation, and proceeding in the examination there was revealed another constriction and another loculus. There were, in fact, two constrictions and three loculi in the stomach—a trifid stomach. As soon as the operator is satisfied as to the conditions which exist the great omentum and transverse colon are lifted out of the abdomen and turned upward over the epigastrium. The under surface of the transverse mesocolon is exposed and the vascular arch formed mainly by the middle colic artery is seen. A bloodless spot is chosen, a small incision made in the mesocolon, and the finger passed into the lesser sac. The opening in the mesocolon is then gradually enlarged by stretching and tearing until all the fingers can be passed through it. It is very rarely necessary to ligature any vessel. The hand of an assistant now makes the posterior surface of the stomach present at this opening, and the surgeon grasps the

stomach and pulls it well through. A fold of the stomach, about three inches in length, is now seized with a Doyen's clamp. The clamp is applied in such a way that the portion of the stomach embraced by it extends from the greater curvature obliquely upward to the lesser curvature and toward the cardiac. The duodenojejunal angle is now sought and readily found by sweeping the finger along the under surface of the root of the transverse mesocolon to the left of the spine. The jejunum is then brought to the surface and a portion of it, about nine inches from the angle, is clamped in a second pair of Doyen's forceps. The two clamps now lie side by side on the abdominal wall, and the portions of stomach and jejunum to be anastomosed are well outside the abdomen embraced by the clamps. The whole operation area is now covered with gauze wrung out of hot sterile salt solution, the clamps alone remaining visible. A continuous suture is then introduced, uniting the serous and subserous coats of the stomach and jejunum. The stitch is commenced at the left end of the portions of the gut enclosed in the clamp, and ends at the right. The length of the sutured line should be at least two inches. In front of this line an incision is now made into the stomach and jejunum, the serous and muscular layers of each being carefully divided until the mucous membrane is reached. As the cut is made the serous coat retracts and the mucous layer pouts into the incision. An ellipse of the mucous membrane is now excised from both stomach and jejunum, the portion removed being about one and three-quarter inches in length and half an inch in breadth at the centre. The stomach mucosa shows a tendency to retract; it is, therefore, seized with a pair of miniature volsella on each side. No vessels are ligatured. The inner suture is now introduced. It embraces all the coats of the stomach and jejunum, and the individual stitches are placed close together and drawn fairly tight so as to constrict all vessels in the cut edges. The suture begins at the same point as the outer one, and is continued without interruption all round the incision to the starting point, where the ends are tied and cut short. It will be found that there is no need to interrupt the stitch at any point, for there is no ten-

dency on the part of the sutured edges to pucker when the stitch is drawn tight. The clamps are now removed from both the stomach and the jejunum, in order to see if any bleeding point is made manifest. Very rarely—about once in ten cases—a separate stitch at a bleeding point is necessary. The outer suture is now reassumed and continued round to its starting point, being taken through the serous coat about one-sixth of an inch in front of the inner suture. This outer stitch is also continuous throughout; when completed, the ends are tied and cut short as with the inner stitch. There are thus two suture lines surrounding the anastomotic opening: an inner, hæmostatic, which includes all the layers of the gut; and an outer, approximating, which takes up only the serous and subserous coats. For both stitches I use thin Pagenstecher thread. No sutures are passed through the mesocolon and stomach. The gut is lightly wiped over with a swab wet in sterile salt solution, the viscera returned within the abdomen, and the partial wound sutured layer by layer. When the patient is replaced in bed the head and shoulders are supported by three or four pillows. The operation lasts from beginning to end about thirty to thirty-five minutes, but can be shortened by five or ten minutes if the condition of the patient demands it.

With regard to the after-treatment there is but little to say. Nutrient enemata are given every four hours, and the bowel is washed out every morning with a pint of hot water; no fluid is given by the mouth for twelve hours, or until the ether sickness is over; then water in teaspoonful doses every fifteen minutes is given, and the quantity increased and the intervals lessened if sickness is not aroused. At the end of forty-eight hours milk and a little pudding, soups, and such like are given. By the eighth day fish and minced chicken are taken, and in less than a fortnight solid food will be relished. The patient generally requires a caution not to overeat during the first month or two, for often the appetite is ravenous.

Hour-glass Stomach. By hour-glass stomach (''bilocular stomach,'' ''hour-glass contraction of the stomach'') is understood that condition in which the stomach is divided into two

compartments by the narrowing of the viscus at or near its centre. The two loculi so formed may be almost equal in size, or one—generally the cardiac pouch—may be very much larger than the other. In one instance (Case 14) I have seen the stomach divided into three pouches, and in another (Case 15) a condition of hour-glass duodenum was associated with hour-glass stomach, so that four pouches—two larger in the stomach, two smaller in the duodenum—were seen. The isthmus connecting the two parts of the stomach is generally found at or near the middle of the viscus; but owing to stasis of the food, the cardiac complement becomes dilated, and is then much larger, thicker, and more capacious than the pyloric. The pyloric pouch is, however, not seldom dilated also, and in such circumstances a pyloric or duodenal stenosis will also be found.

Pathogeny. Hour-glass stomach is usually described as being "congenital" and "acquired." Of these forms the congenital is said to be the more frequent.

I have carefully considered the question as to the existence of hour-glass stomach as a congenital deformity, examining all the specimens that I could find and reading carefully the records of I believe all the published cases; but I remain confident in my belief, expressed in a paper in the *Lancet* two years ago, that there is no evidence whatever which will establish the claim of those who assert that the disease is often congenital in origin. Since I first threw doubts upon the congenital origin of many of the cases of hour-glass stomach, and showed that in almost all obvious evidence of old ulceration could be found, several investigators have supported my conclusion by observations made during the course of operation or on post-mortem examination. There is, indeed, no inherent improbability in the existence of congenital hour-glass stomach, but it lacks proof.

Acquired hour-glass stomach may be caused by (1) perigastric adhesions; (2) ulcer, with local perforation and anchoring to the anterior abdominal wall; (3) chronic ulcer generally at or near the middle of the organ; malignant disease.

1. Perigastric adhesions may result from many causes—gastric

ulcer, old tuberculous peritonitis, inflammatory affections of the gall-bladder, etc. In rare instances these adhesions may be the sole cause of the partition of the stomach; in many they are no more than contributing causes. They were well seen in a case related by Cumston.

2. Ulcer, with local perforation and anchoring of the stomach to the anterior abdominal wall—this was the condition I found in my first case. It results from gradual deepening of a chronic ulcer. As the ulcer approaches the serous coat of the stomach a few adhesions form, binding the viscus to the anterior abdominal wall, and preventing the bursting of the ulcer into the general peritoneal cavity. If the ulcer be on the posterior surface, a soldering to the pancreas may result, as in one case I have recently seen. When the stomach is anchored in its middle the pouches on each side, but more especially on the cardiac side, show a tendency to sagging, and this, with the cicatricial contraction taking place in the ulcer, results in the hour-glass form of the stomach.

In three recorded cases an ulcer at the isthmus of an hour-glass stomach has perforated into the peritoneum and caused death. The first case was related by Siewers, the second by my friend Mr. W. H. Brown, and the third by Thomsen.

3. Chronic ulcer: A chronic ulcer of the stomach is characterized by the thickness and induration at its base. In the healing of such an ulcer, especially if large in size or circular, a considerable amount of contraction will necessarily take place, and a high degree of narrowing of the stomach may result.

Symptoms of Hour-glass Stomach. An hour-glass stomach can be diagnosed with certainty if attention be paid to a certain combination of symptoms. In my first six cases only one was diagnosed; in my last nine cases, seven were diagnosed with certainty; in one of these the diagnosis was made by the medical attendant, Dr. McGregor Young, before I was asked by him to see the patient. The symptoms will naturally vary according to the position of the constriction in the stomach. If this lies near the cardiac orifice, the clinical picture will resemble that given by œsophageal obstruction low down; if near the pyloric orifice, the symptoms are those

of dilated stomach. But, wherever the narrowing may be, attention to the following signs will in almost every case enable a diagnosis to be made with confidence:

1. If the stomach tube be passed and the stomach washed out with a known quantity of fluid, the loss of a certain quantity will be observed when the return fluid is measured. Thus, if thirty ounces be used, only twenty-four can be made to return, as in Dr. McGregor Young's case already mentioned. Wölfler, who called attention to this sign, said that some of the fluid seemed to disappear "as though it had flowed through a large hole," as indeed it has in passing from the cardiac to the pyloric pouch (Wölfler's "first sign").

2. If the stomach be washed out until the fluid returns clear, a sudden rush of foul, evil-smelling fluid may occur; or, if the stomach be washed clean, the tube withdrawn and passed again, in a few minutes several ounces of dirty, offensive fluid may escape. The fluid has regurgitated through the connecting channel between the pyloric and cardiac pouches (Wölfler's "second sign").

3. Paradoxical dilatation—if the stomach be palpated and a succussion splash obtained, the stomach tube passed, and the stomach apparently emptied, palpation will still elicit a distinct splashing sound. This is due to the fact that only the cardiac pouch is drained; the contents of the pyloric remain undisturbed and cause the splashing sound on palpation. For this phenomenon Jaworski has suggested the appropriate name "paradoxical dilatation." Jaboulay has pointed out that if the cardiac loculus be filled with water, a splashing sound can still be obtained by palpation over the pyloric pouch. The sign of paradoxical dilatation is best elicited after washing out the stomach in the ordinary manner. When the abdomen is examined at the completion of the washing and when the stomach has been apparently drained quite dry, a splashing sound is readily obtained, for some of the fluid used has escaped into the pyloric pouch through the connecting channel.

4. Von Eiselsberg observed in one of his cases that on distend-

ing the stomach a bulging of the left side of the epigastrium was produced; after a few moments this gradually subsided, and concomitantly there was a gradual filling up and bulging of the right side.

5. Von Eiselsberg also calls attention to the bubbling, forcing, "sizzling" sound which can be heard when the stethoscope is applied over the stomach after distention with CO_2. If the two halves of a Seidlitz powder are separately given and the stomach be normal or dilated, no loud sound is heard anywhere except at the pylorus; if a constriction is present in the stomach, a loud, forcible, gushing sound can be easily distinguished at a point two or three inches to the left of the middle line.

6. I first called attention two years ago to a sign which I have since found of great service in establishing a diagnosis of hour-glass stomach. The abdomen is carefully examined, and the stomach resonance percussed. A Seidlitz powder in two halves is then administered. On percussing, after about twenty or thirty seconds, an enormous increase in the resonance of the upper part of the stomach can be found, while the lower part remains unaltered. If the pyloric pouch can be felt or seen to be clearly demarcated the diagnosis is inevitable, for the increase in resonance must be in a distended cardiac segment. If the abdomen be watched for a few minutes the pyloric pouch may sometimes be seen gradually to fill and become prominent.

7. Schmidt-Monard and Eichorst have seen a distinct sulcus between the two pouches inflated with CO_2. In Case X., p. 81, in my list, the two pouches with a hard, as I thought, malignant mass between them, could be readily seen. When both pouches were distended with CO_2, alternate pressure upon them showed unmistakably that they communicated through a very narrow orifice, for the one could be emptied slowly into the other, and the fluid could be felt to ripple gently through. The diagnosis in such a case is simplicity itself. In Case VIII. a distinct notch was seen at the lower border of the inflated stomach.

8. Ewald has called attention to two signs which he considers of value in establishing a diagnosis. When the stomach is filled

with water and examined by gastrodiaphany, the transillumination is seen only in the cardiac pouch; the pyloric pouch remains dark.

9. The deglutable India-rubber bag of Turck and Hemmeter is passed and distended. The bulging caused thereby is limited to the cardiac pouch which lies to the left of the middle line.

The two aids to diagnosis of greatest value are, it will be seen, the washing out of the stomach and its distention with gas by the administration of a Seidlitz powder in two portions. The fluid used for the washing must be carefully measured before use; the tube is then passed, and the stomach emptied, the contents set aside in a separate dish, and the washing commenced. All the fluid now returning is collected in a separate vessel and carefully measured. The two signs of Ewald are of little importance; a correct diagnosis can always be made without them.

Differential Diagnosis. The two conditions for which an hour-glass stomach is liable to be mistaken are obstructions in the lower part of the œsophagus and pyloric stenosis. If the constriction in the stomach is within an inch or two of the cardiac orifice, the upper loculus of the stomach will be very small in size, and capable, therefore, of holding only small quantities of food. Food when swallowed may be regurgitated within a few minutes almost unaltered, and the patient may tell the same story of difficulty in "getting the food down" as is told by one whose œsophagus is obstructed. A correct diagnosis can be made by introducing the œsophageal bougie; if the bougie passes over sixteen inches from the teeth, the obstruction probably lies in the stomach.

If the constriction be near the pylorus the cardiac complement will be dilated, and will present the same appearances and signs as a dilated stomach; Wölfler's two signs—1 and 2 in the list given—will generally enable a correct diagnosis to be achieved.

If the obstruction should lie at any point between the two mentioned, there should be no difficulty in making a correct diagnosis.

Treatment. The treatment of hour-glass stomach may be beset with difficulties. If the stricture is near the cardia, or if the cardiac complement be bound up in adhesions, there may be great mechan-

ical hinderance to the performance of any operation. When the abdomen is opened a thorough examination of the whole stomach must first be made. The dilated pyloric sac may so completely resemble the whole stomach as to lead to the performance of a gastroenterostomy between it and a loop of jejunum. Several cases are recorded in which this mistake has been made, and it is, therefore, necessary to emphasize the importance of an examination of the whole stomach up to the cardiac orifice in every case, no matter how obvious the diagnosis of "dilated stomach" may have seemed.

In many cases of hour-glass stomach no single operation will suffice to relieve the symptoms. This is due to the fact that where a stricture is present in the body of the stomach a second stricture near the pylorus may also be found. If there be any dilatation of the pyloric complement a constriction at the pylorus or in the duodenum will certainly be found. This dual stenosis, which has not received adequate attention from any writer, accounts for the lack of permanent improvement seen in many of the recorded cases. If in such circumstances a gastroenterostomy is performed between the cardiac pouch and the jejunum, the pyloric pouch becomes a reservoir, incapable of efficient emptying, wherein food lodges and becomes sour. Symptoms of stasis are then observed, acid, bitter eructations, occasional vomiting, a sense of heaviness and heat at the epigastrium, and distaste for food, and, as in a case recorded by Terrier, a second operation is necessary. If a gastroplasty is performed, the stomach cannot empty itself because of the pyloric stenosis, and the symptoms are unrelieved. Such a condition of double stenosis can, therefore, only be adequately treated by the performance of two operations at the same time—gastroplasty and pyloroplasty, gastroplasty and gastroenterostomy from the pyloric pouch, gastrogastrostomy and gastroenterostomy, or a double gastroenterostomy, a loop of jejunum being opened at two points—at the upper into the cardiac pouch, at the lower into the pyloric.

The following are the operations that may be practised: (1) gastroplasty; (2) gastrogastrostomy or gastroanastomosis; (3) either

of the foregoing, with gastroenterostomy from the pyloric pouch, in cases of dual stenosis; (4) gastroenterostomy from the cardiac pouch, when the pyloric pouch is so small that it can be ignored; (5) gastroenterostomy from both pouches; (6) partial gastrectomy.

The operation selected will necessarily depend upon the condition which is found. Thus I performed gastroplasty alone in Cases I., II., III., V., XI.; gastroenterostomy alone in Cases VI., VII., VIII., IX.; gastroplasty and gastroenterostomy in Cases XII., XIII.; gastrogastrostomy alone in Case IV.; gastrogastrostomy and gastroenterostomy in Cases XIV., XV.

Partial gastrectomy is the operation of choice in cases of malignant stricture in the body of the stomach. Gastroplasty was first performed by Bardeleben in 1889; later by Kruckenberg, Doyen, and others, Gastrogastrostomy was first performed by Wölfler in 1894. In 1895 F. Sedgwick Watson performed a gastroanastomosis by folding the pyloric pouch over the cardiac pouch, with the constriction as a hinge, and uniting the apposed surfaces.

The number of cases upon which this paper is based is as follows: Perforating gastric or duodenal ulcer, 12 cases, 6 recoveries; gastroenterostomy for chronic ulcer, etc., 70 cases, 1 death; pyloroplasty, 3 cases, no deaths; hour-glass stomach, 15 cases, 3 deaths; gastroplication, 1 case, recovered; excision of ulcer for hæmatemesis, 1 case, died.

TABLE I.—CASES OF PERFORATING GASTRIC AND DUODENAL ULCER.

CASE I.—S. A., April 30, 1897. Female, aged thirty-nine years. *Symptoms and Description.* Was admitted with a history of acute onset of severe abdominal pain, chiefly in the epigastric region. There was faintness, followed in about half-an-hour by vomiting; no hæmatemesis. The abdomen gradually became distended, and the pulse gradually became quicker and feebler. *Condition found at Operation.* Abdomen opened and a very small gastric ulcer near lesser curvature found to have perforated. There was free effusion, and some curdled milk was seen in the peritoneum. Suture of ulcer, lavage, and drainage. Recovered. *Remarks.* Infirmary. Time after perforation, about thirty hours.

CASE 2.—M. P., May 22, 1897. Female, aged twenty-seven years. *Symptoms and Description.* During last year was under treatment by

Dr. Bennett for gastric ulcer. Since then has constantly had dyspepsia, pain in the back and epigastrium, and occasional vomiting, but not recently of blood. On Saturday, May 22d, at 2.30 A.M., suddenly roused from sleep by intense epigastric pain, felt faint, and vomited. Collapse continued, and soon distention and tenderness; vomiting was persistent. *Condition found at Operation.* Abdomen generally distended, upper part especially, very tense; pulse only just perceptible, cold, clammy hands, livid skin. Operation 11.25 P.M. Large perforation, one-half inch in diameter, just below lesser curvature nearer cardia. Died 2.40 P.M. *Remarks.* Dr. Bennett, Otley. Time after perforation, twenty-one hours.

CASE 3.—R. S., November 16, 1898. Female, aged twenty years. *Symptoms and Description.* Was under Dr. Johnstone some months ago for indigestion, with dieting, etc., the symptoms abated. No discomfort recently. On November 18th, 5.30 P.M., while at tea, sudden pain, overwhelming, localized beneath ribs on left side "as though a knife were run in." Abdomen gradually distended. Remained collapsed for several hours, but improved after morphine. No liver dulness. Tenderness over appendix region chiefly. *Condition found at Operation.* Operation November 20th, 12 noon. Large ulcer, easily admitting the middle finger, about three inches from cardia on anterior surface. General peritonitis, large collection of thick turbid fluid and lymph. Died in twenty-three and one-half hours. *Remarks.* Dr. Johnstone, Ilkley. Time after perforation, about forty-two hours.

CASE 4.—T. H., April 26, 1900. Male, aged forty-four years. *Symptoms and Description.* Symptoms had been present for eighteen months; the chief of them was pain, two, three, or four hours after food. Blood had been observed when the patient vomited; vomiting was frequent, but irregular. There was no melæna. On April 25th, while in the infirmary, the man became suddenly worse; pain came on acutely in the whole abdomen. Distention and rigidity were soon observed. Collapse was pronounced. Respirations 28, pulse 128. *Condition found at Operation.* A diagnosis of perforating ulcer was made and the abdomen opened. The ulcer was found at the beginning of the second part of the duodenum; its diameter was about three-quarters of an inch. After stitching the ulcer up the gut seemed narrowed to at least half its diameter. A gastroenterostomy, with the aid of a Murphy button, was therefore performed. The patient never rallied from his collapse. Died. *Remarks.* Dr. Veale, Drighlington. Time after perforation, about twenty-six hours.

CASE 5.—M. L., April 12, 1901. Female, aged twenty-eight years. *Symptoms and Description.* Symptoms of indigestion for eight years. On April 11th was suddenly seized with acute abdominal pain, about

three hours after breakfast. On admission to the infirmary she was found to be in very acute pain, the abdomen—especially in the upper half—being much distended and very rigid. The epigastric region was excessively tender. *Condition found at Operation.* An ulcer, equal in size to the end of a lead-pencil, found near lesser curvature, toward the cardia. The stitches held imperfectly until taken very wide of the ulcer. To give security, an omental flap was stitched over the ulcer. The early course was satisfactory, but later the temperature ran up, and a subphrenic abscess and multiple suppuration in the abdomen resulted, and the patient died May 7th. *Remarks.* Infirmary. Time after perforation, twenty-eight hours.

Case 6.—L. T., May 24, 1901. Male, aged twenty-three years. *Symptoms and Description.* Has had symptoms of gastric ulcer for several months. He is a policeman, and has recently been on night duty; frequently has vomited during the night. On morning of May 23, 1901, a sudden acute attack of pain and vomiting when going on duty. He returned to bed, felt ill and cold all day, and at night first sent for a medical man. The abdomen was then distended, rigid, and tender; pulse 124, thin and feeble. *Condition found at Operation.* An ulcer on the anterior surface, near the pylorus, had perforated. There were masses of lymph between the liver and the stomach. Fluid was found everywhere in the peritoneum. The ulcer was about the size of a sixpence. Died. *Remarks.* Dr. Exley, Leeds. Time after perforation, thirty-five hours. Vomiting of digested blood continued for two days: it was very acid, and caused redness of the cheek and chin. At the post-mortem two other acute ulcers found.

Case 7.—T. F., June 18, 1901. Male, aged twenty-five years. *Symptoms and Description.* The patient, a sturdy, robust laborer, stated that for about four weeks before admission he had suffered from indigestion and vomiting. On June 18th, while climbing a ladder, was suddenly seized with intense abdominal pain. He was seen at once by a medical man, who happened to be near, and sent to the infirmary. He was then profoundly collapsed. Breathing quick and short; pulse 128, abdomen rigid and unyielding. A diagnosis of perforated ulcer was made. *Condition found at Operation.* A perforation equal in diameter to a No. 8 or 9 catheter was found in the duodenum, one inch from the pylorus. The ulcer was stitched and the abdomen cleansed and drained. Recovered. *Remarks.* Infirmary. Dr. Rowden, Roundhay. Time after perforation, three hours and fifty minutes.

Case 8.—R. H., March 13, 1902. Female, aged twenty-four years. *Symptoms and Description.* Was married eight weeks ago. Had suffered slightly before that from indigestion, but never severely. Thirty-six hours before operation was suddenly seized with acute intolerable

pains underneath the left costal margin. There was no vomiting, but faintness and collapse were pronounced. Gradually the abdomen began to distend and the pulse to fail. On examination the abdomen was distended uniformly, and was everywhere tender. In the left upper quadrant, beneath the left rectus, a specially tender area. *Condition found at Operation.* An ulcer near the cardia had perforated. The edges for at least an inch round were solid and hard, and stitches cut through when tightly tied. An area of stomach was infolded, and an omental flap stitched like a lid over the line of suture. There were large masses of thick lymph for a few inches round the ulcer. Recovered. *Remarks.* Dr. Bates, Ilkley. Time after perforation, about thirty-six hours.

CASE 9.—I. S., April 20, 1902. Female, aged seventeen years. *Symptoms and Description.* For several weeks had had slight indigestion and epigastric pain, but not in sufficient severity to send her to a doctor. Last night, April 19th, at 9 o'clock, a sudden attack of acute epigastric pain. Morphine given. Seen at 7 A.M.; abdomen very rigid and rather tender, especially over gall-bladder. Has vomited once. Pulse 112. Very shallow respiration. *Condition found at Operation.* An ulcer perforated on anterior surface of duodenum, about three-quarters of an inch from pylorus. Some fluid above the stomach. Ulcer closed by suture; peritoneum cleansed by wiping with swabs wet with sterile salt solution. No lavage, no drainage. Recovered. *Remarks.* Infirmary. Time after perforation, about ten hours.

CASE 10.—Miss E. H., October 11, 1902. Female, aged twenty years. *Symptoms and Description.* In March, 1901, a very severe attack of hæmatemesis, afterward symptoms of indigestion, but never severe. She remained anæmic for several months. In November, 1901, a second attack of hæmatemesis; symptoms of indigestion since, up to three months ago. Latterly has been quite well, better than for years, and has suffered no discomforts from food. On October 10th, at 5 P.M., had tea; at 9 P.M. some broth; at 11 P.M., while undressing, sudden attack of pain under the ribs on the left side, "catching her breath." She was coiled up in bed, groaning with pain, and slightly collapsed up to 2 P.M., when morphine was given. She has been comfortable since. Seen at 3 P.M.; abdomen tight, but not distended, moving very little; tender to the left of umbilicus, especially just beneath costal margin. Pulse 122. No vomiting. We diagnosed perforation on an almost empty stomach. *Condition found at Operation.* A perforation found close to the lesser curvature on the anterior surface, equal in size to a No. 10 catheter. An indurated area, equal at least to a florin, around this. A single stitch put through ulcer to close it, and then ulcer buried by a double continuous suture. A flap of omentum

turned over like a lid. There were many masses of lymph between the stomach and the liver, and free effusion of turbid fluid into the peritoneum; wiped with wet swabs and then dried. *Remarks.* Dr. Burnett. Dr. Oldfield, Leeds. Time after perforation, about sixteen hours. The patient died fifty hours after the operation. The temperature had kept at 104° to 105° for thirty-six hours before death, and the pulse was always over 160.

Case 11.—V. T., November 8, 1902. Female, aged eighteen years. *Symptoms and Description.* For the last few weeks some slight pain after food, just beneath the left costal arch. Pain has been worse when she stretched her left arm upward. Sudden onset of symptoms about 8 P.M., November 7th, pain, collapse, shallow breathing, etc. Abdomen intensely rigid and immobile. *Condition found at Operation.* Perforation about equal in size to a lead-pencil near lesser curvature toward cardia. Some flaky adhesions. Suture. Omental flap. No drainage. Recovered. *Remarks.* Dr. Rowden, Roundhay.

Case 12.—A. M., March 5, 1903. Female, aged twenty-three years. *Symptoms and Description.* Has had indigestion for several months. On March 1st, when in London, had a sudden attack of pain beneath left costal margin; felt faint and prostrate, vomited. Gradually felt better, and on March 3d travelled down from London to Bawtry, and ate a good luncheon on the journey. The side then felt "stiff" and hurt her if she laughed or turned quickly. On March 4th, after breakfast, a sudden extremely severe pain, collapse, and vomiting. Went to bed and has remained there since. Abdomen has gradually distended, and is now blown out and tympanitic; a fluid wave easily felt. Looks very ill. Pulse 156. *Condition found at Operation.* Two perforated ulcers found, both on anterior surface and in cardiac half of stomach near the lesser curvature. They were distant about one and one-half inches from each other. One opening was the diameter of a lead-pencil, the other of a knitting-needle. From both fluid gushed out. Both closed by suture, and stomach folded over. Omental lid afterward covered both in. Drainage by split tube and gauze wick at upper part of incision and through a separate suprapubic incision. Recovered. *Remarks.* Dr. Johnson and Dr. F. Johnson, Bawtry.

Table II.—Gastro-enterostomy for Simple Diseases: Chronic Ulcer of Stomach and Duodenum, Hæmatemesis, Melæna, Pyloric Stenosis, and Dilated Stomach. (* Denotes Hemorrhagic Cases.)

Case 1.—E. B., January, 1900. Female, aged forty-one years. *Symptoms and Description.* At age of sixteen had an illness, attended

with the vomiting of blood, on one occasion in large quantity. Pain after food ever since, at times better, at times worse. Diet has been carefully and rigidly supervised. In June, 1899, pain began to be much more acute, and vomiting, which before had been inconstant, now became frequent. Large quantities (four pints) were vomited. On examination of abdomen, a large contracting stomach seen. Nothing abnormal felt over pylorus. *Condition found at Operation.* Thickening at pylorus, and along first portions of duodenum, with contraction and many adhesions. The adhesions were carefully broken down. A gastroenterostomy was performed, with the aid of Laplace's forceps; the operation being very simple and speedy. Recovered. *Remarks.* Quite restored to health. Eats well and suffers no pain. July 29, 1902: quite well; in "first-rate health."

Case 2.—F. S., February, 1900. Male, aged thirty-five years. *Symptoms and Description.* Prolonged symptoms of chronic ulceration of stomach with hyperchlorhydria. Under medicinal treatment (bismuth and morphine about two hours after meals, etc.) he improved for a time, but eventually treatment induced no improvement. Since June, 1899, has been steadily losing ground. Pain and vomiting, severe and disabling, and of daily occurrence. On examination a large and contracting stomach. *Condition found at Operation.* Very dilated stomach, with pyloric contraction, some thickening and many adhesions. Gastroenterostomy, with Laplace's forceps. Recovered. *Remarks.* Has been very well since the operation. Has gained (July, 1902) about one stone in weight.

Case 3.—A. B., January, 1900, and March, 1900. Male, aged fifty-five years. *Symptoms and Description.* Dyspepsia for ten or twelve years, culminating five years ago in an "attack" which lasted two weeks, and was remarkable for the severity and continuance of epigastric pain and the persistence of vomiting. Since this attack has had periodic seizures of copious vomiting at intervals of twenty-four hours to three weeks. Pain after food, at intervals of three to six hours, varying greatly in severity, but generally not amounting to more than discomfort. On one occasion in hospital the vomited matter measured five and one-half pints. The stomach was huge and flabby, but contractions were always visible. HCl present. *Condition found at Operation.* Enormous stomach. When distended with two Seidlitz powders the outline of the greater curvature descends behind the symphysis pubis. An ulcer was found extending onward into the duodenum, cicatricial contraction very marked, adhesion to liver. Gastroenterostomy by the aid of Laplace's forceps, and separation of old adhesions. Recovered. *Remarks.* Dr. Bailey, Horsforth. Patient reports (August, 1902) himself "as well as ever he was in his life, and able

to eat anything.'' This patient returned to hospital in March. After operation there was considerable relief for about a month. Then, after a heavy meal, consisting largely of boiled peas, there was an attack of pain and vomiting, and from that date the symptoms gradually returned. On admission his condition was practically the same as before operation. The abdomen was again opened, and a second gastroenterostomy, with the aid of Murphy's button, performed. The opening made at the first operation, between the stomach and intestine, was practically closed. Patient made a good recovery. When seen in September, 1900, he said he was ''never better in his life, had gained over two stones in weight, and had no gastric anxieties or discomforts.''

Case 4.—F. H., June, 1900. Male, aged thirty-two years. *Symptoms and Description.* Symptoms of ulcer, ''acid dyspepsia,'' ten months ago; relieved for one month by bismuth and morphine. For seven months severe pain after food, worse about two hours after a meal. Vomiting every two or three days up to three months ago, since then almost daily; stomach dilated and contracting. Lost two stones in weight. Free HCl. *Condition found at Operation.* Dense ring at pylorus, sharply defined, and about five-eighths of an inch in breadth. A few adhesions which separated readily. Posterior gastroenterostomy without mechanical aid. Recovered. *Remarks.* Has regained lost weight, and can eat heartily without discomfort.

Case 5.—S. H., August 1, 1900. Aged forty-nine years. *Symptoms and Description.* Nine months ago first noticed pain in epigastric region after eating; five months ago first vomited; pain and vomiting speedily increased in frequency and severity. Now the pain commences about one or two hours after food, and continues until vomiting comes on spontaneously or is induced. No blood has ever been noticed in the vomit. No solid food has been taken for two and one-half months; the chief diet is milk and soda. Considerable wasting. A dilated stomach is obvious on examination. On distention by Seidlitz powder, the greater curvature descends two and one-half inches below the umbilicus, and contractions—faint but distinct—are seen. Free HCl. *Condition found at Operation.* Hard cicatricial rings at pylorus, a few adhesions to liver; the finger, invaginating the anterior wall of the stomach, feels and recognizes the pyloric orifice merely as a dimple. Posterior gastroenterostomy by suture without mechanical appliances. Recovered. *Remarks.* ''Complete relief.'' Report, July, 1902. Is perfectly well, and can eat and digest ordinary food.

Case 6.—T. H., June 6, 1900. Male, aged fifty-two years. *Symptoms and Description.* For several years has suffered from indigestion. During the last six months has suffered acutely; pain and vomiting have become increasingly frequent. He has lost three and one-half stones,

and looks pinched and ill. The stomach is very largely dilated, and is easily seen contracting. Free HCl is present. *Condition found at Operation.* A thick, tough mass at the pylorus, densely adherent. A few enlarged glands near the tumor. Anterior gastroenterostomy. Recovered. *Remarks.* Dr. Clarke, Doncaster. Weight before operation, seven stones. Dr. Clarke writes on July 6, 1902: "I saw J. H. this morning, looking well. He now weighs ten and one-half stones, his old weight. He is doing his ordinary work, and is in splendid health."

Case 7.—A. C., January 15, 1901. Female, aged fifty-two years. *Symptoms and Description.* Menopause five years ago. Since then has been subject to attacks of vomiting, increasing in frequency and severity; vomited blood at the beginning of these attacks, but not lately. Pain after food constantly, generally one to two hours after. Is relieved by vomiting. On examination a very dilated stomach, with obvious contractions. On filling with CO_2 stomach is seen to descend one inch below umbilicus. Free HCl. Traces of lactic acid. Oppler-Boas bacilli. No tumor felt. *Condition found at Operation.* A large pyloric tumor, with many adhesions, especially behind gland, felt at head of pancreas and along the lesser curvature. Removal found quite impossible. Posterior gastroenterostomy. Recovered. *Remarks.* Dr. La Touche, Ossett. In July, 1902, this patient was in good health, very stout, and the "wonder of the countryside." The tumor was thought to be possibly malignant.

Case 8.—W. B., February 22, 1901. Male, aged sixty years. *Symptoms and Description.* Had an "ulcerated stomach" twenty years ago; gastric uneasiness ever since. During last two years has been under constant treatment by many doctors. Pain severe and constant, increased by solid food: in epigastrium radiating round and through left side to back. Very rarely vomits; stomach dilated; no wave-like contractions observed. Is said to have passed tarry stools. Has lost weight (two stone nine pounds). Taken only liquids; very little of them. Free HCl a trace. A trace of lactic acid. Diagnosed malignant disease implanted on ulcer. *Condition found at Operation.* Stomach a little dilated; quite close to pylorus on the anterior wall; an ulcer equal in size to a shilling, with puckering of serous coat, a little thickening and induration, but clearly not malignant. Posterior gastroenterostomy. Recovered. *Remarks.* Sent by Mr. Stansfield. Weight at operation, eight stones eight pounds; June 5th, ten stones three pounds; September, 1902, ten stones eight and one-half pounds.

Case 9.—L. S., February 19, 1901. Female, aged thirty-one years. *Symptoms and Description.* For several years attacks of gallstone colic. Seven months ago removal of stone impacted in cystic duct.

Uneventful recovery from operation. Since then symptoms of dilated stomach; copious vomiting at intervals of two or three days; pain, uneasiness, feeling of distention after food. Stomach below umbilicus; waves seen without distention with CO_2. *Condition found at Operation.* Large stomach. Innumerable tough adhesions between gall-bladder, abdominal wall, and stomach. Impossible to liberate them, so gastroenterostomy was performed. Recovery. *Remarks.* Dr. Waugh, Skipton (Hospital). September, 1902. Quite well. Eats heartily, and has absolutely no pain.

Case 10.—E. W., February 20, 1901. Female, aged twenty-seven years. *Symptoms and Description.* Has been continually under medicinal treatment for nearly two years. Suffers from pain before food, when stomach is empty, and after taking food in anything but very small quantities. Pain when fasting is relieved by a drink of milk and a small biscuit, anything more causes pain after an interval of a half-hour. Vomiting has been occasional; no blood. Has been kept at rest and dieted for a long period without any result. Tenderness in epigastrium; distention slight. *Condition found at Operation.* An ulcer equal in size to a shilling about one inch from pylorus. During the operation a marked circular contraction of stomach at the site of ulcer was seen. The stomach seemed as though tied with a tape; pale, densely hard, and narrow. When firmly contracted the mass formed a tumor about as large as a golf ball. Posterior gastroenterostomy. Recovery. *Remarks.* Dr. Waugh, Skipton (Hospital). September, 1902. Very well indeed. Has made a perfect recovery.

Case 11.—S. B., February 16, 1901. Female, aged fifty-one years. *Symptoms and Description.* For some years has had pain after food and diarrhœa. For last five or six months pain has been much more severe after every meal. It comes on about a half-hour after food, and lasts for three hours or more. Vomiting is infrequent, unless self-induced to obtain ease. On two occasions has noticed blood, but only in small quantities. Has lost health and strength, and has thinned. Continuous treatment for five months has proved unavailing. Tenderness on pressure over pylorus. Doctor writes: "Had tried all the usual drugs without relief, that nothing could be taken without great pain, and she was losing flesh and strength." Stomach a little dilated, excess of HCl. *Condition found at Operation.* Three ulcers found. Two in stomach near lesser curvature, one about an inch from pylorus, the second two and one-quarter inches, one in first part of duodenum, with considerable induration. Posterior gastroenterostomy by simple suture. Recovered. *Remarks.* Dr. Lockwood, Halifax. Made a good recovery. When seen three months after the operation had gained ten pounds in weight.

Case 12.—M. B., February 5, 1901. Female, aged fifty-six years. *Symptoms and Description.* Five years ago an operation was performed for removal of gallstones. There were many adhesions round the pylorus. For two years had symptoms of pyloric obstruction, for which posterior gastroenterostomy was done by a colleague, Murphy's button being used. For over a year was very much better. Then symptoms recurred. Vomiting copious; pain intolerable. Diet limited to thin fluids. On examination the stomach was dilated to left of umbilicus, and seemed anchored toward pylorus. *Condition found at Operation.* The peritoneum was with difficulty opened owing to the numberless and dense adhesions, which were quite bewildering. The posterior surface of the stomach was adherent to the anterior abdominal wall at place of former anastomosis. A second wide anastomosis was now made immediately beyond the first one. On introducing one finger into the stomach and another into the jejunum, the first opening was found to be almost or completely closed. Recovery. *Remarks.* Dr. Hick. Weight seven stones six pounds. February 6, 1902, eight stones five pounds. Takes food well, no pain; "highly satisfied."

Case 13.—M. H., February 12, 1901. Female, aged twenty-two years. *Symptoms and Description.* Indigestion for nine months, quite intractable. Begun with a severe attack of pain, accompanied by vomiting, lasting three days; blood noticed in vomit during first day. Since then pain always after food, generally one and one-half hours after, radiates to right shoulder. Vomits frequently, but at very irregular intervals. She has had bismuth and morphine and much medical treatment, but absolutely without more than temporary benefit. Stomach down to umbilicus and splashy. *Condition found at Operation.* Stomach dilated as result of an ulcer about one and one-half inches on cardiac side of pylorus; much induration, and a few adhesions to abdominal wall and gall-bladder. Posterior gastroenterostomy, by suture. Recovery. *Remarks.* Dr. Milne, Mirfield. Has been seen at intervals since. Can take ordinary food in any quantity.

Case 14.—M. A. G., February 11, 1901. Female, aged forty-four years. *Symptoms and Description.* Symptoms began twelve months ago. Pain in body after meals, which had been trivial for many years, became then troublesome, generally felt about one and one-half hours after food. Radiated round right side to the back. Vomiting every day or two as a rule. On a few occasions did not vomit for days. Has noticed blood once only. Very rigid and tender over pyloric area. Stomach dilated to right below umbilicus. Free HCl. *Condition found at Operation.* Large stomach. Puckering and induration on posterior surface of pylorus, adherent to pancreas. Posterior gastroenterostomy. Recovered. *Remarks.* Dr. Clements, Farnley. Sep-

tember, 1902: "Quite well and very grateful for what has been done."

*Case 15.—M. P., March 19, 1901. Male, aged thirty years. *Symptoms and Description.* Symptoms five or six years. Pain in epigastrium after meals; most severe in bed at night, slight pain between shoulders. Vomiting for twelve months, almost regularly on alternate days. "Watery phlegm very sour;" once blood. Lost nearly a stone in weight. Always careful in diet. Has attacks of faintness, prostration, and melæna. *Condition found at Operation.* Ulcer in first portion of duodenum, with many adhesions. Small scar of gastric ulcer on posterior surface. Posterior gastroenterostomy. Recovery. *Remarks.* Dr. Millhouse. Dr. Anning. May 31, 1901, gained twelve pounds. Eats well. No "attacks" since operation. Weight, November, 1902, eight stones nine pounds.

*Case 16.—M. C., April, 1901. Male, aged forty-eight years. *Symptoms and Description.* Under medicinal treatment five years with stomach disorder. Has been carefully dieted; still is always expecting, and generally has, pain, distention, uneasiness after food. Has bled freely several times recently. Stomach dilated. The symptoms since Christmas have been those of Reichmann's disease. Hyperchlorhydria. The recent occurrence of severe hemorrhage, necessitating rest two or three days in bed, has alarmed him. The attacks have left him anæmic and prostrate, and he has lost over a stone in weight. *Condition found at Operation.* Large ulcer at least size of a florin on the posterior surface, near the pylorus. A scar of a smaller ulcer is seen on posterior surface about three inches from the pylorus. Posterior gastroenterostomy. Owing to stoutness and rigidity of muscles, I was hampered during the operation, and made a smaller opening than usual. Recovery. *Remarks.* Dr. Ellis, Halifax. A ventral hernia in upper part of scar. A Pagenstecher thread, with which I stitched up the abdominal wall, suppurated and discharged itself. Report, August, 1902: "In robust health."

Case 17.—W. K., April 29, 1901. Male, aged fifty-nine years. *Symptoms and Description.* Soldier twenty-five years. Has been ill two and one-half years. At first loss of appetite, indigestion, and flatulence. Has attacks of severe pain, limited to upper right quadrant of abdomen, followed by vomiting. These came two or three times a week; vomiting always relieves them. Has lost fours tones. On two occasions—June, 1899, and March, 1901—has vomited bright blood. On last occasion melæna also noticed; stomach descends to within two inches of the pubes, and is seen actively contracting. *Condition found at Operation.* A hard mass at pylorus, and a thickening of head of pancreas. (Probably simple, though possibly malignant.) Stomach

shows scars of three ulcers. Posterior gastroenterostomy. An example of chronic pancreatitis due to gastric or duodenal ulceration. Recovered. Dr. Basil Housman, Edgeley, Stockport. Weight, eight stones five and one-half pounds. June 26th, gained thirty-one pounds, and perfectly free from pain. Died of pneumonia in December, 1901. Was better in health before this than for many years. "The pyloric tumor had disappeared. He could eat and digest anything, and was quite a hearty man." (Dr. Housman.)

Case 18.—E. J. W., May, 1901. Female, aged forty-eight years. *Symptoms and Description.* "Gastric ulcer," 1889. Since then digestive disturbances. Pyroplasty in January. Complete relief for about five weeks; then return of all symptoms. Very tender and rigid beneath upper part of right rectus. Hæmatemesis three times recently. *Condition found at Operation.* Much induration and thickening at pylorus, with some adhesions. The ulceration had widely extended. Posterior gastroenterostomy. Recovered. *Remarks.* Dr. E. R. F. Mason, Gomersal. Was quite well after gastroenterostomy.

Case 19.—Mrs. H., June 20, 1901. Female, aged thirty-seven years. *Symptoms and Description.* Has had indigestion for twenty years. Pain after food, vomiting at intervals of four days at the longest. Never has a "good meal;" cannot eat solid food. Five years ago an acute attack of vomiting, lasting several days; a similar attack seventeen or eighteen months ago. On both occasions blood was noticed. She says, "I've no pleasure in living, and can't go on as I am." Stomach dilated to two inches below umbilicus; faint waves; no gurgling or forcing sounds. A thin, sallow, dyspeptic woman. *Condition found at Operation.* Dilated stomach. Three distinct scars on anterior surface, one at pylorus with much induration and omental adhesions. Two on stomach side of that. A few adhesions on the posterior surface. Posterior gastroenterostomy. Recovered. *Remarks.* Dr. B. W. Housman Edgeley, Stockport. Weight before operation, five stones eleven and one-half pounds. Weight, April, 1902, six stones ten pounds. In September, 1902, Dr. Housman writes: "Can enjoy any ordinary food and is in complete comfort. She is very grateful indeed. Is better than she has ever been in her life." Weight, December, 1902, seven stones twelve pounds.

*Case 20.—A. H., November 7, 1901. Female, aged twenty-four years. *Symptoms and Description.* Has had characteristic symptoms of gastric ulcer for about eighteen months. For the last six months has been kept in bed under medicinal treatment, but has vomited almost daily, and on all occasions blood in greater or less quantity has come. Is very pallid and anæmic. In hospital she vomited daily fresh and partially-digested blood. She is very much blanched, has attacks of

fainting in bed, and looks very ill. *Condition found at Operation.* An ulcer, close to pylorus, with thickening over an area the size of a shilling. A dense, hard area, with reddened surface and edges, covered with lymph on the posterior surface. Posterior gastroenterostomy, an ulcer, probably the bleeding one, on posterior surface being excised, and the opening left united to the jejunum. Recovered. *Remarks.* Dr. Clarke, Wakefield. Was in the Manchester Union Infirmary in 1902. Was said to have recently had attacks of vomiting, but when carefully watched no vomiting was observed, and she was discharged.

Case 21.—N. W., August, 1901. Female, aged twenty-eight years. *Symptoms and Description.* Stomach trouble since twelve years old. Pain after food and vomiting; never hæmatemesis; no melæna. If she takes a meal now, feels full and uncomfortable for about one and one-half hours, then pain, generally becoming acute, leads to vomiting, which gives ease. Constant uneasiness. Stomach dilated and proptosed. *Condition found at Operation.* Ulcer found near pylorus on greater curvature; a few adhesions. Very large flabby stomach. The pancreas seen above the lesser curvature. Recovered. *Remarks.* Dr. F. W. Robinson, Huddersfield. Had slight regurgitant vomiting for twelve days, relieved by first washing out the stomach; no feeling of sickness after. Rapidly gained health and strength. In August, 1902, "Very well indeed." In December, 1902, "Very well indeed."

Case 22.—T. T., November 2, 1901. Male, aged forty years. *Symptoms and Description.* Symptoms began in June, 1900; burning pain and vomiting after food, generally one-half hour after a meal. No hæmatemesis. Two months ago an attack of vomiting, lasting two days; extreme irritability of stomach. No melæna. On examination, a huge stomach, contracting. Free HCl. Loud gurglings at pylorus. Has had severe cramps in muscles of neck and extremities. Tetany. *Condition found at Operation.* Enormous stomach. Several ulcers (five well marked) in stomach, and one just beyond the pylorus. Posterior gastroenterostomy. Recovery. *Remarks.* Dr. Millhouse and Dr. G. P. Anning, Kirkstall. Weight before, eight stones six and one-half pounds. April, 1902, nine stones three and one-half pounds. Can eat anything without discomfort; feels better than for years.

Case 23.—F. D., November 30, 1901. Female, aged nineteen years. *Symptoms and Description.* Twelve months ago began to have pain after food, coming generally about one-half hour after a meal, and increasing in severity for two hours. This is becoming more severe, and is now extreme and disabling. Constant feeling of sickness after food, and retching; vomits only every week or ten days, and then in copious quantities. No hæmatemesis, and no melæna. On examination, a dilated stomach to one inch and three-quarters below umbilicus. Free

HCl. Lavage and medicines have been tried for four months without any benefit. *Condition found at Operation.* Very dilated stomach; a scar of large indurated ulcer found about one and one-half inches from the pylorus. Posterior gastroenterostomy. Recovered. *Remarks.* Dr. Tyrie, Keighley. Has "gone on splendidly." August, 1902.

Case 24.—E. W., December, 1901. Female, aged nineteen years. *Symptoms and Description.* Has complained of pain after food and vomiting for sixteen months. Hæmatemesis at the onset, but only on two occasions in last twelve months. Pain comes on almost immediately after food. Vomits at least every week. Pain is at once relieved if she lies on the abdomen prone. Dilated stomach. Free HCl. *Condition found at Operation.* No ulcer on anterior surface. On posterior surface a large indurated scar. The posterior surface of the stomach was very adherent to the upper layer of transverse mesocolon; the lesser sac being partly obliterated. Posterior gastroenterostomy. Recovered. *Remarks.* Dr. Tyrie, Keighley. Had a sharp attack of bronchitis for three days after the operation. In September, 1902, was quite well; eating heartily, and had gained about ten pounds in weight.

*Case 25.—N. G., January, 1902. Female, aged twenty-six years. *Symptoms and Description.* For last few months has had pain, always after food, coming on immediately and lasting for three or four hours. Has, therefore, limited her diet and has lost weight. Four weeks ago had hæmatemesis and melæna. The melæna has continued ever since, and is now threatening to end disastrously. Has fainted in bed several times. Pulse 96. She is very pallid, and has become much thinner during the last four weeks. *Condition found at Operation.* An ulcer in stomach on posterior wall. An ulcer, elongated and thickened in duodenum, feeling like a date. Many adhesions. Posterior gastroenterostomy. Recovered. *Remarks.* Dr. Ellis, Halifax. This patient made a perfect recovery, and in September, 1902, was reported to be in perfect health. She has regained her lost weight and seven pounds over.

Case 26.—M. R., February 3, 1902. Male, aged forty-three years. *Symptoms and Description.* Long-standing stomach trouble. Began twenty years ago; pain after food and vomiting. Has been more or less subject to indigestion, and has carefully limited his diet, vomiting from time to time in large quantities. Motions occasionally tarry. Last October a sharp attack of hæmatemesis and melæna. Stomach now very dilated two inches below umbilicus. In last four months has lost a stone in weight. *Condition found at Operation.* Very large flaccid stomach. At the pylorus and a little beyond much thickening, forming a tumor equal in size to a walnut. On anterior surface a distinct scar about three inches from pylorus. On posterior surface a similar scar with

adhesions to transverse mesocolon. Posterior gastroenterostomy. Recovered. *Remarks.* Dr. Ellis, Halifax. In August, 1902, heard that he was in good health, quite free from stomach troubles, and had gained a stone in weight.

Case 27.—S. H., March 17, 1902. Female, aged thirty-four years. *Symptoms and Description.* Has suffered intermittently with indigestion since she was thirteen years old. For the last six years she has been worse, and for the last two years she has "not had a bite of solid food," living on milk and milk and soda. Vomiting of blood six years ago; neither before nor since. Now vomits large quantities, and says that her stomach "seems to fill up for two or three days and then has to be emptied." Weight, five stones seven pounds. Very large stomach; on distention reaches to within one inch of the umbilicus. Free HCl. *Condition found at Operation.* An enormous stomach. The pyloric antrum is covered with cicatrices, forming an almost continuous fibrous mass. Posterior gastroenterostomy. Recovered. *Remarks.* Dr. B. W. Hogarth, Morecambe. Weight before operation, five stones seven pounds. Never vomited once after operation; was taking solid food when she returned home on seventeenth day. Dr. Hogarth writes in May, "She is enjoying better health than ever before." May 28th. Weight, six stones seven and one-half pounds. September, 1902. "I have been doing seventeen or eighteen hours' work a day, and my work has not been a burden to me as it was before the operation." Weight, six stones ten and one-half pounds.

Case 28.—M. N., April 17, 1902. Female, aged twenty-five years. *Symptoms and Description.* For several years has suffered from a chronic indigestion. Symptoms date from a sudden attack of vomiting, with blood-stained ejection. Pain about half an hour after food; body becomes very distended; belching is frequent and vomiting occasional. Latter always gives relief. During last June symptoms much worse. Constant indigestion, vomiting, and wasting. Stomach reached before distention one and one-half inches below the umbilicus. *Condition found at Operation.* A very large flabby stomach. On the anterior surface, near the pylorus, an ulcer about one and one-half inches long by one-half inch wide, very thick and indurated. Posterior gastroenterostomy. Recovered. *Remarks.* Dr. Sproulle, Mirfield. Has made a perfect recovery. Eating well and absolutely free from any discomfort. Weight, six stones one-half pound. Weight, January, 1903, seven stones eight pounds. Eats well and enjoys food.

Case 29.—A. W., April 2, 1902. Male, aged thirty-eight years. *Symptoms and Description.* Symptoms of ulcer of the stomach fifteen years ago. In bed for six weeks; pain, hæmatemesis, and wasting. Ever since has had chronic indigestion; never able to eat a hearty meal;

solid food causes distention, pain, and vomiting. Now vomits about twice a week, and has measured the amount on two occasions recently, on each five pints. Very dilated stomach, splashing and contracting. *Condition found at Operation.* Dilated stomach. On the posterior surface of the stomach the scar of a large chronic ulcer, with many adhesions to it from transverse mesocolon. Ulcer about three to four inches from the pylorus; some adhesions also at the pylorus. Posterior gastroenterostomy. Recovered. *Remarks.* Dr. F. W. Halliday. This patient vomited one pint of altered blood on four occasions in first twenty-four hours after operation. Had regurgitant vomiting about twice weekly after the operation. Was then ordered to wash the stomach out twice weekly; since then has been better, though he feels bilious and disinclined for food at times. In January, 1903, vomited a "slough," after this improved rapidly; was able to eat well, and gained one pound in weight every week.

CASE 30.—M. F., April 17, 1902. Female, aged twenty-nine years. *Symptoms and Description.* From childhood has had trouble with the stomach. Constant indigestion. Four years ago a severe prostrating attack, in which she vomited frequently, and blood came on several occasions in large quantities. Indigestion very much worse since that attack. Constant regurgitation. In early December last year a similar attack, called "gastric ulcer" by Dr. Smith; she was in bed three months. Since getting up has had intolerable pain, constant vomiting, and has wasted considerably. Stomach dilated and very tender over pyloric area. Free HCl in excess. *Condition found at Operation.* Large stomach. Ulcer on anterior wall near the pylorus as large as a shilling, thick and very hard. Adhesions of great omentum to it. Posterior gastroenterostomy. Recovered. *Remarks.* Dr. Smith, Hunslet. Made an excellent recovery. By September had gained eleven and one-half pounds in weight.

CASE 31.—M. R., June 4, 1902. Female, aged twenty-seven years. *Symptoms and Description.* Five years ago had an acute attack of abdominal pain, vomiting, etc. Was in bed twenty-two weeks. The doctor who saw her and the consultant diagnosed "perforating" ulcer of the stomach. Constant indigestion, pain, and vomiting since then; can never take solid food, and ordinary liquid diet causes pain and uneasiness. Vomits every three or four days now. Stomach moderately dilated. *Condition found at Operation.* Very dense and numerous adhesions on posterior surface of the stomach, especially thick and tough near the pylorus. A fairly large stomach. Posterior gastroenterostomy. Recovered. *Remarks.* Dr. Millhouse and Dr. Anning. Made a very good recovery.

CASE 32.—M. A., June 12, 1902. Female, aged thirty-seven years.

Symptoms and Description. About ten years ago began with pain and sickness; she was laid up in bed on several occasions. The vomiting was "dreadful," but no blood was ever observed. For seven years continual indigestion. At the end of that period alarming hemorrhage; was in hospital five weeks. Vomiting and pain have continued intermittently since. Was advised by consultant to undergo operation last year. Dilated stomach; for several months has noticed occasionally that stools "were black as ink." *Condition found at Operation.* Numerous adhesions at the pylorus and duodenum, especially on the posterior surface. A very large stomach. Some marked local thickening of the head of the pancreas. Posterior gastroenterostomy. An example of chronic interstitial pancreatitis due to gastric and duodenal ulceration. Recovered. *Remarks.* Dr. Ellis, Halifax. By August had gained twelve and one-half pounds. By September four additional pounds. On October 15th two stones heavier than at the time of the operation. In February, 1903, had gained six pounds more.

Case 33.—M. G., July 2, 1902. Male, aged forty-seven years. *Symptoms and Description.* Has had indigestion for four or five years, gradually increasing in severity until the present time, when he is disabled from work. Pain after food was the first symptom, coming on about one and one-half hours after a meal, and increasing in severity for an hour, unless eased by vomiting, which always afforded relief. There has never been hemorrhage. On examination a very large stomach, descending about one and one-half inches below umbilicus, before inflation. A few contractions seen on inflation. Has "cramps" in his arms and hands, rarely in his legs; especially noticed during the last two months. Tetany. *Condition found at Operation.* A very large stomach. A large scar on the posterior surface, near the pylorus. A second scar at the beginning of the second portion of the duodenum. Many adhesions around pylorus. Posterior gastroenterostomy. Recovered. *Remarks.* Dr. A. A. McNab. Made a rapid recovery, and within three weeks was eating ordinary meals with great relish.

Case 34.—M. H., July 19, 1902. Male, aged thirty years. *Symptoms and Description.* Illness dates from four years ago, when he had an attack of hæmatemesis, bringing up about a pint of blood. He was kept in bed about a month, and apparently made a complete recovery. A year later he developed symptoms of dyspepsia, there being vomiting, especially at night; there was no further hæmatemesis. Under treatment he improved considerably. Eighteen months later the same symptoms reappeared, and have remained since, gradually increasing in severity. He now vomits two or three times a week in very large quantities. The stomach reaches to the pubes, and can be seen actively contracting. He is very thin and much wasted and shrunken; he has

not been able to eat solid food for months. Free HCl found on three occasions; no lactic acid. *Condition found at Operation.* An enormous stomach, thickly hypertrophied. Dense scarring at and near the pylorus. A few external adhesions. Posterior gastroenterostomy. This was quite the thickest stomach wall I have seen, and it would be approximately one-third of an inch thick; the increase being due largely to hypertrophy of muscle. Recovered. *Remarks.* Dr. Woodyatt, Halifax. Weight before, six stones ten and one-half pounds. Weight four weeks after operation, seven stones five and one-half pounds. He could then eat heartily and take any solid food. In February, 1903, had gained over two stones.

*Case 35.—M. W., July 19, 1902. Female, aged twenty-four years. *Symptoms and Description.* For fifteen months has had symptoms of gastric ulcer, pain, vomiting, and inability to take solid food. Eleven weeks ago the symptoms became pronounced. Vomiting became frequent. During the last five weeks has vomited daily, and on almost all occasions blood has come. While waiting in hospital she vomited three times in five days, and on each occasion almost half a pint of blood came away. She is very blanched. Pulse 112. The motions were slightly tarry on two occasions. Her general appearance is that of profound anæmia. *Condition found at Operation.* Stomach moderately dilated. On the anterior surface near the pylorus were two scars equal in size to a threepenny-piece, distant about one inch from each other. A few thin adhesions between these and the anterior abdominal wall. On the posterior surface near the pylorus an indurated area about one inch in diameter, with reddened area around it, and covered by recent lymph, was found. Several adhesions to the transverse mesocolon. Posterior gastroenterostomy. Recovered. *Remarks.* Dr. Eskrigge, Royston. An excellent recovery. Vomited once after operation on sixth day about four ounces of bile; no blood. In September had gained eight pounds in weight, and was eating well. In February, 1903, was "still improving," and in excellent health.

Case 36.—M. C., July 21, 1902. Female, aged thirty-five years. *Symptoms and Description.* When eighteen to twenty years of age suffered severely from chlorosis. Four years ago she fell from a ladder, striking the upper part of the abdomen. She was in bed for a fortnight, and suffered great pain and swelling in the upper part of the abdomen. Since this time has had pains after food, fulness, and feeling of tight distention, vomiting, and loss of weight. On examination a large dilated stomach, reaching a little below the midpoint between umbilicus and pubes. An example of gastric ulcer due to traumatism. *Condition found at Operation.* A web of adhesions around the pyloric end of the stomach and posteriorly; densest near the pylorus on the posterior

surface. A very large flabby stomach. Posterior gastroenterostomy. Recovered. *Remarks.* Sent by Dr. Johnstone and Dr. Hearder, Ilkley. Weight before operation, seven stones one-half pound. Weight three weeks later, seven stones eight pounds. Has improved steadily.

Case 37.—E. W., July 29, 1902. Female, aged thirty-two years. *Symptoms and Description.* Symptoms have lasted one year. First noticed discomfort after food, and later acute pain, always in the pit of the stomach. Vomiting set in early and was frequent. Blood was observed on several occasions; the most vomited at one time was "about a teacupful." Latterly has had to limit her diet solely to fluids. On examination a tumor as large as a cocoanut found over the pylorus, slightly movable during respiration, a little tender. The stomach is very much dilated. Free HCl always present. *Conditions found at Operation.* A large tumor at the pylorus and many adhesions to liver, abdominal wall, and pancreas. All perfectly smooth and "finished off." No irregular nodules anywhere. I believed the mass to be inflammatory and performed gastroenterostomy. Recovered. *Remarks.* Dr. Baxter-Tyrie. Weight, August 2d, six stones. Weight, August 22d, six stones seven pounds. Appetite quickly increased, and food was taken freely and without discomfort. In February, 1903, had gained one and one-half stones.

Case 38.—J. H., August 7, 1902. Male, aged thirty-one years. *Symptoms and Description.* Ten months' history of pain after food and gradual loss of weight. All solid food has been abandoned little by little, and now a fluid diet causes pain, occasional vomiting in large quantity, and distention. Twice had hæmatemesis. The pain is frequently felt about one and one-half hours after food. He has lost exactly four stones in the last nineteen weeks. A very dilated stomach. Free HCl present. *Condition found at Operation.* While lying under the anæsthetic on the table the dilated stomach showed prominently. It descended a hand's-breadth below the umbilicus. On opening the abdomen a thickening of the duodenum above the bile-papilla was felt; the first portion of the duodenum and the stomach were very markedly dilated. Posterior gastroenterostomy. Recovered. *Remarks.* Dr. Norman Porritt, Huddersfield. A good recovery, eating solid food before leaving the hospital. Has had occasional fulness after meals and slight pain, but has eaten heartily and gained twelve and one-half pounds in weight (October 20th). Gained one stone (December 8th). "Feeling stronger."

Case 39.—C. W., August 23, 1902. Male, aged twenty-three years. *Symptoms and Description.* Has suffered from indigestion for nearly four years; pain and vomiting almost daily. Has never noticed any blood. Now vomits once or twice weekly in large quantity. A very

dilated stomach. On inflation it descends three and one-half inches below the umbilicus. Free HCl. No lactic acid. *Condition found at Operation.* Adhesions between anterior wall of stomach and parietal peritoneum. On separating these a scarring of the stomach wall. A very large stomach. Posterior gastroenterostomy. Recovered. *Remarks.* Dr. Readman, Skipton. Seen October 14th. Had gained one stone in weight. Eating well and heartily. In February, 1903, quite well.

Case 40.—W. L., August 25, 1902. Male, aged nineteen years. *Symptoms and Description.* For eighteen months had suffered from indigestion, which, in spite of temporary improvement for a week or two under treatment, has steadily got worse. He saw me four months ago, and I advised lavage and medicinal treatment, but no benefit resulted. His diet is now almost entirely liquid, causes him incessant pain, and every week or so he vomits copiously. A very large splashy stomach. Has slight tetanic contractions of the hands. Free HCl. *Condition found at Operation.* A large stomach. On the posterior surface many and thick adhesions, especially near the pylorus. Posterior gastroenterostomy. Recovered. *Remarks.* Dr. Waugh, Skipton. Gained six pounds in weight before leaving the hospital. In January, 1903, a stone heavier.

Case 41.—J. W. R., August 28, 1902. Male, aged forty-six years. *Symptoms and Description.* Symptoms date from last December. Pain over ensiform cartilage and vomiting. The vomiting was first and chiefly noticed after he had been in bed an hour or two. He had occasionally to get up three or four times. At Easter the vomiting became more copious, but less frequent. Occasionally "dark brown, with a very bad smell." The stomach is very prominent, standing out boldly from the rest of the abdomen, and is actively contracting. Free HCl. *Condition found at Operation.* The most hypertrophied stomach I have seen. The whole wall at least one-half inch in thickness. A thick, hard ring at the pylorus and many adhesions. Posterior gastroenterostomy. Recovered. *Remarks.* Transferred from Dr. Chadwick. Eating heartily and had gained five pounds on discharge. In October had gained sixteen pounds more. In February, 1903, had gained two stones ten pounds since the operation.

Case 42.—A. S., August 28, 1902. Male, aged twenty-seven years. *Symptoms and Description.* For two and one-half years had had "dyspepsia." Complains chiefly of pain on the right side over the pylorus. which begins two hours after a meal, and gradually increases. He feels "as if he wanted to vomit and can't," belches sour and offensive gas at intervals. Has severe cramps in muscles of arms, back, and occasionally legs. Lives entirely on milk. Stomach dilated to one and one-

half inches below umbilicus. Free HCl in excess. *Condition found at Operation.* A scar near the pylorus, about the size of a sixpence. A few adhesions to this and immediately beyond. Similar adhesions on the posterior surface. Posterior gastroenterostomy. Recovered. *Remarks.* Dr. I. Taylor. Solid food on eleventh day. Eating full diet on discharge.

*Case 43.—M. P., October 4, 1902. Male, aged twenty-nine years. *Symptoms and Description.* He has suffered for several years from a "weak stomach," having pain after food, two or three hours after, and occasionally vomiting. Was in his usual state of health until August 31st last. On that day he had a long and tiring bicycle ride, which left him weary. On Sunday ate heavily and had much discomfort. On Sunday night he got out of bed, owing to the feeling of fulness in the stomach and the great uneasiness. He induced vomiting, and the bowels were then moved. He felt faint and cold. On Monday was feeling very tired, so did not get up; still ill and weakly on Wednesday. The stools on both days were quite black. On Wednesday he fainted once while in bed, and felt very chilled. On Thursday the bowels were opened four times, and large tarry stools passed. On Tuesday he was noticed to be very pale; his pallor increased on Wednesday very decidedly. On Thursday morning was seriously ill. Pulse 122, very blanched; felt "dead tired," and the bowels were moving frequently, and on all occasions blood was coming. When I saw him he looked desperately ill. His face and mucous membrane of the mouth blanched to the last degree. *Condition found at Operation.* We diagnosed chronic duodenal ulcer, with acute deepening and the opening of some large vessel. Operation was advised as a last resort. On opening the abdomen the stomach was found very dilated and full of gas; it contained no blood. The first portion of the duodenum was also dilated. About one inch from the pylorus a dense, hard mass (equal in size to a walnut) was felt, adherent to the pancreas. Excision of this ulcer was impossible, and, therefore, gastroenterostomy was performed. The jejunum at the point opened contained brownish altered blood. The transverse colon was a most vivid dark blue in color and full of blood. Recovered. *Remarks.* Dr. Fearnley, Harrogate. This patient was in a most critical condition. I have never seen any patient, even after a severe accident, so blanched. While being lifted on to the operating-table he complained of being tired and cold, and then fainted.

Case 44.—Miss B., September 16, 1902. Female, aged thirty-seven years. *Symptoms and Description.* Has had indigestion for "many years." Eighteen months ago she had "perforated gastric ulcer" of the subacute type, diagnosed by Dr. Bishop. Since then her stomach symptoms have been intolerable. Pain constant and gravely increased

by food of any kind; vomiting at least every other day, fermentation, and eructation of obnoxious gas. She has vomited frequently half a chamber utensil full of sour semidigested food. She has "lost a lot of flesh," The stomach is very large, obviously standing out on her thin abdomen. The washing out required forty-nine pints before the fluid returned clean. Free HCl. *Condition found at Operation.* The stomach was buried in adhesions to both anterior and posterior surfaces. The whole outline of the stomach was warped. The posterior surface was exposed with some little difficulty, owing to adhesions to transverse mesocolon. Posterior gastroenterostomy was done. I was dissatisfied with the way in which the anastomosis seemed to "sit" after returning within abdomen. Reflux vomiting occurred; 132 ounces of deeply bile-stained fluid were vomited in two days. I therefore reopened the abdomen and performed an antero-anastomosis between the afferent and efferent limits of the anastomosing loop. Recovered. *Remarks.* Dr. R. W. S. Bishop, Kirby Malzeard. Gained nine pounds in weight. She often remarked, "I'm surprised at myself eating so much."

Case 45.—Miss T., September 25, 1902. Female, aged twenty-eight years. *Symptoms and Description.* She has had stomach troubles since she was fifteen. "Attacks" of pain, vomiting, and inability to take food, lasting two to three weeks. Then for a week or two she is much better, until another "attack" commences. Has had continuous medicinal treatment without lasting benefit. During the last six or eight months her pain has been constant, a "dull ache" increased by food and eased by vomiting. Has not been able to take an ordinary meal for at least six months. On examination the stomach is just down to the umbilicus. There is marked epigastric tenderness on firm pressure. Free HCl. Never hæmatemesis. *Condition found at Operation.* A large stomach. Along the lesser curvature, near the middle of the stomach, is a broad indurated band about two inches in length, and one inch in breadth. On the posterior surface this is felt and seen more clearly than on the anterior, and a few adhesions are found. Posterior gastroenterostomy. Recovered. *Remarks.* Dr. O'Connell, Keighley.

Case 46.—Mrs. B., September 25, 1902. Female, aged sixty years. *Symptoms and Description.* Has been failing in health for nine to ten months. The chief symptom has been vomiting. At the onset a sudden seizure of vomiting, very acute, and lasting over twenty-four hours. There has been a series of attacks of vomiting. Pain is noticed about an hour before a meal is due, and lasts from a few minutes to two or three hours; is never very severe. She has lost flesh and has got weaker, occasionally having to spend a part of the day in bed. No melæna. No hæmatemesis. A small, hard tumor felt above and to the right of the umbilicus, a little movable. On distention with CO_2 an enormous

stomach, reaching a full hand's-breadth below the umbilicus. *Condition found at Operation.* A very large stomach. On the posterior surface of the stomach one large ulcer with several thick adhesions around it. In the second portion of the duodenum the tumor is found. It is a mass about the size of a large walnut, adherent to the pancreas, with which it seems inseparably connected. The duodenum above this point looks distended. Probably chronic duodenal ulcer with interstitial pancreatitis. Recovered. *Remarks.* Dr. Welch, Stanningley. In January, 1903, was eating heartily and was free from all discomforts.

*Case 47.—T. B., September 24, 1902. Male, aged thirty-two years. *Symptoms and Description.* On April 9th of this year patient was suddenly seized with an acute attack of pain in the right hypochondrium. He vomited frequently, and some blood was noticed. The attack lasted two hours, and subsequently the motions were seen to be tarry. Since then he has suffered almost constantly from flatulent distention of the abdomen, especially after food. On several occasions he has had very severe attacks of pain in the right hypochondrium, lasting one or two hours and "doubling him up." Each attack has been followed by profuse tarry stools, and on two occasions has been accompanied by hæmatemesis. The pain is chiefly situated above and to the right of the umbilicus; the painful spot can be covered by a finger-tip. There has never been jaundice. He has lost three and one-half stones in weight since February. The stomach is a little dilated. Free HCl is in excess. *Condition found at Operation.* A duodenal ulcer occupying the first and second portions of the duodenum was found. It was about the size of a walnut, very thick, and adherent to the pancreas. Posterior gastroenterostomy was performed. The gall-bladder was found full of stones. These were removed, and a few stones from the hepatic duct were easily squeezed along the cystic duct into the gall-bladder. The latter was drained. The stones numbered 1885. Recovered. *Remarks.* Dr. Mackenzie, Burnley. Operated upon at the infirmary for Mr. Mayo Robson.

Case 48.—W. S., October 1, 1902. Male, aged thirty-nine years. *Symptoms and Description.* Symptoms first appeared three years ago, quite suddenly. After drinking in the early morning, on an empty stomach, two glasses of beer, he was suddenly seized with a violent attack of vomiting and profound collapse, lasting two to three hours. There was no blood. Has since this been subject to occasional erratic outbursts of vomiting. Abdominal discomfort has been present daily, and is worse after food. He has taken no solid food for three months, as he "could not bear the pain." He has noticed "black-looking stuff" in the vomit, which his doctor has told him is blood. The stomach is distended, reaching one and one-half inches below the umbilicus. Free

HCl. *Condition found at Operation.* A tight cicatricial pylorus showing evidences of old ulceration. The induration of the ulcer extended for about an inch along the duodenum on the upper surface, which is adherent to the liver. Posterior gastroenterostomy. Recovered. *Remarks.* Dr. La Touche, Ossett. December 1st, has gained one stone two pounds since operation. Eating heartily.

Case 49.—J. H., October 6, 1902. Male, aged thirty years. *Symptoms and Description.* Has had symptoms of gastric ulcer for five years; pain after food about one or two hours after every ordinary meal; occasional vomiting; some eructations; melæna. During the last six months the pain has come about three hours after food, and has always been easier if a little fluid food or a biscuit has been taken. He is quite unable to take ordinary food, and treatment, though carefully followed out, has not helped him. Is losing weight, and is becoming progressively anæmic. Has a large splashy stomach. Melæna has not been noticed for two months. *Condition found at Operation.* A moderately dilated stomach; the scar of a duodenal ulcer found just beyond the pylorus. Some thickening and puckering. On the posterior surface of the stomach, near the pylorus, a white scar, the size of a French bean. Some adhesions to the upper surface of the transverse mesocolon. Posterior gastroenterostomy. Recovered. *Remarks.* Dr. H. De C. Woodcock, Leeds.

Case 50.—F. G., October 20, 1902. Female, aged thirty-eight years. *Symptoms and Description.* Well up to three years ago. Then pain after food and vomiting; pain was felt about one-quarter to one-half an hour after food, and was relieved by vomiting. Food and mucus were ejected, occasionally a "dark-brown bitter fluid." During the last twelve months has vomited daily, and has curtailed her diet. For the last six months has taken only Benger's food, cocoa, milk pudding, etc., not any solid. On examination a very large stomach, reaching three and one-half inches below the umbilicus. Contractions faint, though quite distinct. Free HCl. *Condition found at Operation.* A large stomach. A dense series of scars near the pylorus, with many slight adhesions. The pyloric antrum much scarred. The rest of the stomach very large and rather thick. Recovered. *Remarks.* Dr. I. Taylor, Beeston Hill.

Case 51.—J. H. B., October 30, 1902. Male, aged twenty-eight years. *Symptoms and Description.* For fourteen months has had indigestion. At the onset an acute attack of indigestion lasting five days; occasional vomiting then, but no blood. He fainted several times and had tarry motions. During last three months has become progressively worse, has lost over a stone in weight, has constant pain after food and occasional vomiting. Can now take only fluids and is "wearing down" fast. Moderately dilated stomach. Free HCl. Old blood noticed

in stools in infirmary almost daily. *Condition found at Operation.* Duodenal and gastric ulcers. Duodenal ulcer in first portion, about the size of a threepenny-piece, very hard, and slightly adherent. A scar on posterior surface of stomach near the pylorus. Died. *Remarks.* Dr. Stamp Taylor, Leeds. Hernia of almost the whole small intestine through opening in the transverse mesocolon. Death on tenth day.

Case 52.—M. S., November 1, 1902. Male, aged thirty-six years. *Symptoms and Description.* Has suffered from his stomach for twenty years. Dull pains between the shoulders after food, exquisite pain and tenderness in the epigastrium. Vomits occasionally. Is always very careful and sparing in his diet; any excess is at once followed by an "attack" lasting three or four days. Since May of this year has lived on semisolids; he has lost one stone ten pounds in weight. He has frequent tingling and numbness in both hands and severe cramps in the calf of one leg, sometimes in both legs, when in bed at night. Recently has had cramps in the thighs. These attacks of cramp set in almost simultaneously with a seizure of vomiting after he has been in bed a short time. Has had to give up work. Free HCl. *Condition found at Operation.* A moderately dilated stomach, reaching two inches below umbilicus. Active contractions can always be seen. The right side of the epigastrium is very tender, and the right upper rectus is very rigid. Recovery. *Remarks.* Dr. Readman, Skipton. Appetite rapidly returned.

Case 53.—J. R., November 29, 1902. Male, aged thirty-six years. *Symptoms and Description.* Severe and increasing dyspepsia for many years. Is now reduced to fluid foods, and the taking of these causes almost constant pain and occasional outbursts of vomiting. Has been losing weight recently. Looks pale, careworn, and thin. *Condition found at Operation.* On exposing the stomach a large and densely-indurated and adherent ulcer was found on the lesser curvature, fast to the liver and pancreas. A linear scar on the anterior surface of the stomach, running obliquely, was at least two and one-half inches in length, and felt like a wheal of keloid. There were several other scars on both surfaces. Posterior gastroenterostomy. Recovered. *Remarks.* Dr. B. W. Housman, Edgeley, Stockport. This patient began to improve at once and rapidly. He was eating ordinary meals heartily within a fortnight.

Case 54.—I. S., December 2, 1902. Female, aged seventeen years. *Symptoms and Description.* In April of this year had an operation for perforation of a duodenal ulcer. For the first two months all went well, but she was never able to take full diet freely. During the last two months the stomach has been very irritable, only fluids have been taken. Pain and discomfort after foods have gradually increased. Stomach

dilated, especially toward the cardiac end. *Condition found at Operation.* Innumerable adhesions. The posterior surface of the stomach could not be reached on account of adhesions of omentum, transverse colon, etc.; nor could the duodeno-jejunal flexure be reached. The cæcum was therefore found, and the ileum traced upward from it to the highest point of the jejunum free from adhesions. A Roux's operation was then performed to the anterior surface of the stomach. The cæcum and colon were contained in a mesentery common to them and to the small intestine. Recovered. *Remarks.* Dr. Wainman, Leeds. By March, 1903, had gained eleven pounds in weight.

Case 55.—W. P., December 12, 1902. Male, aged fifty-six years. *Symptoms and Description.* For thirteen years the patient had suffered from severe indigestion. At the beginning of this period he had an acute gastric ulcer; hæmatemesis and severe pain being the symptoms. (The diagnosis was made at that time by his medical man.) Since then the stomach has been dilated. Pain and a sense of weight are constant after solid foods, so that the diet has voluntarily been restricted almost entirely to fluids. Vomits two or three times a week. On examination stomach much hypertrophied and reaching three inches below umbilicus. Waves of contraction easily seen. *Condition found at Operation.* A thick dilated stomach. The pyloric region was very hard and gristly for the extent of an inch. There were adhesions from this area to the liver. Old ulceration with considerable induration and adhesions. Posterior gastroenterostomy. Recovered. *Remarks.* Dr. Woodcock. Weight, eight stones one and one-half pounds. Was seen by a surgeon, with a view to operation eight years ago. Operation not advised.

Case 56.—M. E. P., December 27, 1902. Female, aged thirty-two years. *Symptoms and Description.* This patient stated that she had suffered from her stomach "all her life," and that since the age of fourteen she had "never had a day's ease." After all food, even fluids, there was pain and sickness. Twelve months ago an attack of hæmatemesis. Under observation in hospital it was found that if a quantity of milk greater than three ounces were given, some was vomited within a few minutes. Patient said it was eight years since she had been able to drink a glass of milk at once. On insufflation the stomach becomes prominent, but is decidedly smaller than normal. Vomiting was excited by distention. *Condition found at Operation.* Multiple scars on the stomach. Perigastritis. The stomach not dilated at any part; on the contrary, smaller than normal, and toward the pyloric end so densely scarred and so adherent as to be converted into a rigid tube. Posterior gastroenterostomy. The anastomosis made at cardiac side of the contracted portion. Recovered. *Remarks.* Dr. Thorman, Kirkburton.

This patient had other manifestations of congenital syphilis. It is possible that the gastric condition was due to syphilis.

Case 57.—W. B., January 7, 1903. Male, aged thirty-seven years. *Symptoms and Description.* Patient says that he has been troubled with his stomach "all his life;" but during the last twelve months the symptoms have been very much worse. About half an hour to an hour after food there is severe burning pain in the epigastrium, and sour eructations begin and last for two or three hours. Every two or three days has attacks of vomiting; very large quantities of food are ejected, and he has frequently recognized food taken two or three days before. The vomit at times "smells and tastes rotten." He had "bad rounds," even in childhood. Has lost one and one-half stones in last few months. On examination a very large splashing stomach. *Condition found at Operation.* On opening the abdomen a very large and somewhat hypertrophied stomach was found. The pylorus was thick and fibrous, and felt almost solid. On the posterior surface of the stomach about three inches from the pylorus two hard nodules of scar tissue were felt, about an inch apart. Posterior gastroenterostomy. Recovered. *Remarks.* Dr. E. R. F. Mason, Gomersal. In March, 1903, had gained nine pounds in weight. Had a small stitch abscess in abdominal wall. A catgut ligature removed.

*Case 58.—A. S., January 17, 1903. Female, aged twenty-eight years. *Symptoms and Description.* In May, 1898, a sudden attack of hæmatemesis and fainting. Was in bed six weeks. For eighteen months subsequently very poor health, indigestion, vomiting, and constipation. Then six months of good health. In April, 1900, indigestion began again; was under medicinal treatment for six months with much benefit. In January, 1902, hæmatemesis, and again treatment in bed for four weeks. Four months ago another attack of hæmatemesis. Saw Dr. Rowling then for first time; was in bed under treatment for seven weeks. During the last months symptoms have returned. Pain comes on about an hour after food, sometimes just after food. She vomits three or four times a day. On examination a tender epigastrium —pressure causes a pain through to the back. No dilatation of stomach. Excess of free HCl. *Condition found at Operation.* On examination an ulcer was found about three to four inches from the pylorus, close to the lesser curvature. It was as large as a shilling, very dense, and adherent to the pancreas behind. A second ulcer was found in the duodenum, just beyond the pylorus, about one-quarter of an inch in diameter. Posterior gastroenterostomy. Recovered. *Remarks.* Dr. Rowling. By March had gained five pounds in weight. Eating well.

*Case 59.—J. E., January 22, 1903. Male, aged forty-seven years. *Symptoms and Description.* In January, 1902, when returning from

Las Palmas, had a severe attack of melæna. Several years before this had been subject to indigestion and inability to eat heartily, but for a few months before this attack of bleeding had been in better health than usual. Since this attack has had many others of melæna and hæmatemesis. Has been in a nursing home in London for thirteen weeks, under treatment for duodenal ulcer; while there had occasional severe bleedings, and his hæmoglobin count was only 18 per cent. On examination he was very thin and anæmic. A dilated, obviously contracting stomach seen, from which he shortly afterward vomited a quart of fluid containing blood. This patient looked very worn and ill. It was necessary to infuse saline solution during and after the operation. The day and the night before operation he had copious melæna. *Condition found at Operation.* An enormous stomach, slightly hypertrophied. The first portion of the duodenum was embedded in a mass equal in size to a lemon; inflammatory thickening round an ulcer. On the greater curvature an ulcer equal in size to a shilling near pylorus. Posterior gastroenterostomy. Recovered. *Remarks.* Dr. Bampton, Ilkley. Seen in consultation with Dr. Barrs. Was soon able to take ordinary diet. By March, 1903, had gained seven pounds. Had a severe attack of diarrhœa, lasting four days, in the fifth week.

Case 60.—J. H. W., February 3, 1903. Male, aged thirty-seven years. *Symptoms and Description.* Has had indigestion for several years. The onset of symptoms very gradual; pain after food was first complained of, then vomiting, at intervals at first of a week or longer. On the whole these symptoms have gradually increased in severity. In December, 1901, began to be very much worse; pain followed all foods, and he has lost appetite, vigor, weight. For several months his stomach "has been on strike." He has vomited in large quantities every three or four days. On examination a very much dilated stomach, faintly contracting. Excess of HCl. Has lost one and one-half stones in last three months. *Condition found at Operation.* A very much dilated and slightly thickened stomach. Anterior surface normal. On posterior surface close to the pylorus was a hard circular area, equal in size to a florin, densely hard. There were a few adhesions to the outer surface. Posterior gastroenterostomy. Recovered. *Remarks.* Dr. I. Taylor.

Case 61.—S. J. S., February 9, 1903. Female, aged fifty-six years. *Symptoms and Description.* In February, 1892, was in the infirmary for removal of an ovarian cyst. In the notes it is said that the patient then suffered much from indigestion, and on one occasion had melæna. Since then Dr. Woods has attended her for chronic indigestion. On several occasions there has been severe melæna. In December, 1901, hæmatemesis. In 1887 a medical man diagnosed an acute illness as

"ulcerated stomach." Now has pain two or three hours after a meal all over upper part of abdomen, and frequently "heaving and vomiting." Can now take nothing solid except biscuits. During last twelve months has lost over three stones in weight. In September, 1902, a prolonged attack of melæna. Has persisting anæmia. *Condition found at Operation.* A mass the size of a Tangerine orange found in first portion of the duodenum. Milky opacity of the overlying peritoneum. In the stomach near the greater curvature, about four inches from the pylorus, an ulcer equal in size to a sixpence. The omentum was crumpled up and adherent over it. Recovered. *Remarks.* Dr. Woods, Batley.

Case 62.—C. E. F., February 15, 1903. Female, aged thirty-one years. *Symptoms and Description.* First vomited blood five or six years ago; slight indigestion always since. The symptoms have been greatly increased during the last fourteen months. At the onset pain about two hours after food was the chief. Vomiting is often copious, and hæmatemesis has occurred twice recently, once thirteen months ago, once about a fortnight ago. For eleven months has been quite unable to take any solid food. Now vomits about twice a week, always in very large quantities. Has lost weight in last two months. On examination the stomach which reaches to within two inches of the pubes is seen actively contracting. Free HCl in excess. *Condition found at Operation.* The stomach is very large at the pylorus, and about one inch on stomach side a tough ring of cicatricial tissue. There are two scars on anterior surface of old ulcers, elongated patches of tough white pylorus tissue. Posterior gastroenterostomy. Recovered. *Remarks.* Dr. Woodyatt, Halifax.

Case 63.—G. B., February 19, 1903. Male, aged sixty-two years. *Symptoms and Description.* Has suffered from indigestion and vomiting for several years. Says he does not remember when he was able to take an ordinary meal in comfort. Three years ago was seen by a physician, who diagnosed pyloric stenosis and gastric dilatation, and advised operation. Since then the vomiting and pain have increased to such a degree that the patient says he "cannot go on any longer." On examination an enormous stomach actively contracting. *Condition found at Operation.* A large hypertrophied stomach. There were several scars on the stomach. The pyloric region, on both gastric and duodenal sides, was scarred and stenosed. Posterior gastroenterostomy. Recovered. *Remarks.* Dr. Adams, Sowerby Bridge.

Case 64.—M. W., February 19, 1903. Female, aged thirty years. *Symptoms and Description.* Onset of gastric symptoms ten years ago; quite gradual onset, pain after food, loss of weight and appetite. Phthisis then suspected. Two years ago the pain became more acute after all foods, solid or fluid. Vomiting at times. On examination a dilated

stomach was found, and lavage advised. Twelve months ago a distinct peristalsis of stomach was observed. Now a dilated and contracting stomach easily seen without distention. Has been losing weight rapidly during the last few weeks. *Condition found at Operation.* A dense scarred area at the pylorus and for an inch on gastric side. A very dilated stomach. A second ulcer near the greater curvature on the posterior surface. Posterior gastroenterostomy. Recovered. *Remarks.* Dr. Hearder, Ilkley. Dr. Carter, Sheffield.

Case 65.—F. E., February 20, 1903. Female, aged thirty years. *Symptoms and Description.* Had a gastroenterostomy done a year ago, and made a good recovery. Since then has had occasional vomiting of bile. This has become more frequent lately, and in hospital was almost a daily occurrence. *Condition found at Operation.* Roux's operation. The anastomosis was most satisfactory. The afferent loop was divided close to the stomach; its distal end closed and the proximal implanted into efferent loop. Recovered. *Remarks.* Infirmary. No vomiting after operation. Soon took food in good quantity, and gained weight.

Case 66.—Mrs. S., February 20, 1903. Female. *Symptoms and Description.* Five years ago had an attack of hæmatemesis. Three years ago a second attack. Sixteen months ago a third. Since the first attack has always been subject to indigestion. Has been most carefully treated by rectal feeding for several weeks, rest in bed, etc., but has never responded to the treatment. Since September has been under continuous treatment. Latterly has been unable to take even fluid food without great pain. Is now very blanched and ill. Pulse 112, feeble. A very dilated and tender stomach. A full examination was not possible owing to patient's extreme weakness. *Condition found at Operation.* A very dilated stomach. At the pylorus and along the lesser curvature a large indurated mass. The lesser sac was almost obliterated by adhesions, which made the clamping of the stomach extremely difficult. The anterior surface had no adhesions. An anterior gastroenterostomy would have been simpler. I performed the posterior, however. Two pints of saline infusion given, as the patient's condition was very bad. Recovered. *Remarks.* Dr. Willans, Ovenden. Menstruation began about two hours before the operation. An abscess formed in the abdominal wall.

Case 67.—Mrs. F., March 3, 1903. Female, aged forty years. *Symptoms and Description.* Five years ago had a severe attack of hæmatemesis, from which she nearly died. She was in bed under treatment for four months. Since then has had chronic indigestion. Pain came about one and one-half hours after food. Vomiting occasionally. Appetite always poor. Four days ago another attack of bleeding, and twelve hours ago a third attack; both these were copious. On exami-

nation the stomach was felt to be full. The patient was blanched; pulse 120, respirations 28. Epigastrium tender and painful. Operation urged, in the fear that further hemorrhage might prove serious. *Condition found at Operation.* Two ulcers found. One near the pylorus, about the size of a shilling, rather hard, and showing recent bands of adhesion from the omentum. A second linear ulcer on the posterior surface about four inches from the pylorus. No attempt made to deal with ulcers. A posterior gastroenterostomy was rapidly performed. Recovered. *Remarks.* Dr. H. J. Clarke, Doncaster.

CASE 68.—Miss Dalton, March 6, 1903. Female, aged twenty-one years. *Symptoms and Description.* Stomach symptoms began in October, 1901; pain after food, generally one and one-half hours after, occasional vomiting. Symptoms have gradually become worse. Pain occurs after all foods—a heavy burning sensation. Vomits copiously three or four times a week. On examination a very large and hypertrophied stomach. *Condition found at Operation.* A dense fibrous induration at the pylorus, producing marked stenosis. A few omental adhesions. No other ulcers found. Posterior gastroenterostomy. Recovered. *Remarks.* Dr. Woodcock, Leeds.

*CASE 69.—M. P., July 10, 1902. Male, aged eighteen years. *Symptoms and Description.* Four years ago had scarlet fever. Since then has never been quite robust. Has suffered at times from pain after food and vomiting. These would be present for two or three days, then would abate, and he would be quite well for a few weeks. Has been careful in his diet. An ordinary hearty meal would invariably arouse the symptoms. Had no hæmatemesis. On July 6th ate an ordinary breakfast; late in the morning felt ill, epigastric pain and vomiting. At first vomiting seizure only food came back; at the second a "quart of blood." Later in the day vomited blood—a pint and a half—measured by his doctor. On the 7th vomited blood twice, on each occasion over a pint of clot; on the 8th, twice; on the 9th, three times; on the 10th, once in large quantity and once in small. When I saw him he was very blanched, his face waxen and sweating. The pulse was 114, very thin and feeble. He had been free from abdominal pain since the attack of vomiting. The hemorrhage had told upon him severely. The persistence of symptoms of gastric ulcer for four years, with hæmatemesis of five days' duration, made the diagnosis chronic gastric ulcer, with recent deepening of the ulcer. It was probable that the bleeding from a dense indurated area would not stop spontaneously. Therefore, advised operation. *Condition found at Operation.* The abdomen was opened through the right rectus muscle. Almost at once a hard patch about the size of a shilling was felt in the anterior wall of the stomach, near the lesser curvature toward the car-

diac end. This was the ulcer. It was cut out between two elliptical incisions. The horizontal wound thereby resulting was closed transversely. A careful examination of the rest of the stomach was made, but nothing abnormal found. The abdomen was closed in the usual manner. Died. *Remarks.* For a week the progress of the case was most satisfactory. On the ninth day, immediately after the administration of an enema, the patient complained of faintness, he became collapsed, and died within a few minutes. No post-mortem examination was allowed.

TABLE III.—PYLOROPLASTY FOR PYLORIC ULCER AND STENOSIS.

CASE I.—T. W., Male, aged thirty-eight years. *Symptoms and Description.* Twelve years ago had "ulcerated stomach," a sharp illness lasting about a fortnight, attended with extreme pain in the epigastric region and on the right of that, frequent vomiting, but no hemorrhage. More or less indigestion ever since this attack; has never felt able to eat indiscriminately, but has carefully selected his diet. Now marked dilatation of stomach and obvious peristaltic contractions. Vomits every three or four days, in large quantities. On examination of stomach contents, free HCl is found. *Condition found at Operation.* Scar of ulcer exactly at pylorus; puckering, but no adhesions. Pyloric channel equal in size to a No. 8 or 9 catheter. Pyloroplasty. Recovered. *Remarks.* Quite well in August, 1900. Has gained two stones, and eats "anything." Since then has had slight return of symptoms, occasional indigestion, no vomiting.

CASE 2.—A. H., September, 1899. Male, aged thirty-six years. *Symptoms and Description.* When eighteen years of age had an illness which his medical attendant at that time told him was due to an "ulcer on his stomach." For the last eighteen years—half his life—has had daily attacks of indigestion, except for a period of nearly two years, which terminated six years ago. Has lived for last three to four years entirely upon fluids. Has tried all medicines without lasting advantage. For twelve months has washed the stomach out daily once or twice. Now has pain after every meal, beginning about two hours after, and lasting until vomiting is induced or lavage is employed. Stomach dilated and splashy. Wave-like contractions very distinct. Nothing felt on palpation over pylorus. *Condition found at Operation.* Scar of ulcer at pylorus, no adhesions, but decided limited thickening; pyloric channel just admits a director. Pyloroplasty. Recovered. *Remarks.* Patient writes: "Restored to perfect health after eighteen long years of suffering. I am heavier than I have ever been before." In October, 1902, was still well and eating without any discomfort.

Case 3.—E. J. W., January 12, 1901. Female, aged forty-eight years. *Symptoms and Description.* Illness fourteen months ago; called "gastric ulcer" by her medical man. There was acute pain, after the taking of anything by the mouth, for three days, followed by a sharp attack of vomiting, in which she lost a "pint" of blood. On the following day the pain was easier, but vomiting continued, and a little blood was noticed. She has not taken solid food, except on infrequent occasions since then. There has always been pain after food, beginning about one and one-half hours after. Vomiting has been irregular. Sometimes does not vomit for three days, sometimes many times in one day. On examination dilated stomach, reaches down to umbilicus. Contraction waves seen after distention with gas, faintly. Free HCl. No lactic acid. *Condition found at Operation.* Scar of an ulcer about one inch from the pylorus. Puckering of serous coat. The little finger could not be made to enter the stricture. No adhesions. Pyloroplasty was performed. Opposite the stricture the stomach was equal in diameter to a No. 8 or 9 catheter. Recovered. *Remarks.* Dr. E. R. F. Mason, Hill Top, Gomersal. Ate ordinary diet for one week before discharge; no discomfort and no vomiting. See list of "Gastroenterostomies," May, 1901.

Table IV.—Hour-glass Stomach.

Case 1.—August, 1899. Female, aged thirty-nine years. *Symptoms and Description.* Ten years ago the patient had an illness characterized by profound anæmia. Seven months ago there were clear symptoms of ulcer of the stomach, but neither then nor at any time any acute illness suggestive of perforation. Now vomits after all ordinary food, and more often than not even after small quantities of fluid food. Pain after food was exceedingly severe. On examination of abdomen a dilated stomach could be felt. At one point, a little to the left of the middle line and slightly below the ensiform cartilage, was an area of two inches in diameter, which was markedly tender and offered increased resistance on palpation. This area was found at the operation to correspond precisely with the area of stomach adhesion. The patient had lost weight and deteriorated seriously in general health during the last few months. *Condition found at Operation.* Hour-glass stomach, the narrow constriction being near the middle of the stomach and adherent to the anterior abdominal wall over an area equal to a crown-piece. On each side of this the stomach dilated, and seemed to be anchored by the adhesion. On separating the stomach from the abdominal wall, an opening into the viscus was exposed, and the stomach contents escaped. This opening was enlarged transversely, and the wound and

fistula were stitched up vertically. An omental graft was brought to cover in the sutured area in order to guard against future anchoring. Recovered. *Remarks.* For a month after the operation there was pain at times and loss of appetite. Since then she has been free from pain and in excellent health. Appetite and digestion are good. Patient seen with Mr. Bailey, Horsforth. In February, 1902, condition was still perfectly satisfactory.

Case 2.—April, 1900. Female, aged twenty-seven years. *Symptoms and Description.* There was no history of gastric ulcer. The patient had complained of irregular attacks of pain in the epigastric region for eleven months, always associated with the taking of food, and coming on about one hour after a meal. Vomiting was occasional and irregular, in rather large quantities; there was no blood. On examination the stomach was distended and splashy; contractions were seen when distended. Medical treatment had proved unavailing. *Condition found at Operation.* Hour-glass stomach. The constriction was about four inches from the pylorus; the passage between the two sacs equalled in diameter a No. 12 catheter. There were marked induration and puckering, but no adhesion to the abdominal wall or elsewhere. The strictured neck was divided by an incision about two and one-half inches long in the transverse direction, and stitched up vertically, the mucous membrane with a continuous catgut suture and the serous with a continuous silk suture. Two additional interrupted sutures were applied at each end of the wound. Recovered. *Remarks.* Vomiting for five days after the operation, blood-stained. Since then perfectly well. Patient seen with Dr. Waugh, Skipton. In March, 1902, reported to be in complete health.

Case 3.—January 24, 1901. Hospital; Registered No. 443. Male, aged forty-five years. *Symptoms and Description.* Ailing for three years. Pain in the epigastrium radiating to the left chest. Was worse after food, attack coming on "within half an hour," and lasting for from two to four hours, unless relieved by vomiting. Frequently vomited about an hour after food; never any blood. Lately the pain had been almost constant, aggravated by food, and eased by vomiting. Had lost two stones twelve pounds. Dilated stomach. On distending with CO_2, a notch was noticed at the upper border of the stomach, and a tentative diagnosis of hour-glass stomach was made. Free HCl. A trace of lactic acid and a few rod-shaped bacilli. *Condition found at Operation.* An hour-glass stomach. The scar of the ulcer was equal in size to a florin, was situated close to the lesser curvature, and nearer the cardiac orifice than the pyloric. There were much puckering and induration of the surface. There were no adhesions. The index finger entered, but could not pass the stricture. An incision three and

one-half inches long was made transversely, and stitched longitudinally in two layers. A slender adhesion of gall-bladder to the pylorus was divided. (Gastroplasty, gastrolysis.) Recovered; before leaving the hospital, took the ordinary diet without any discomfort. *Remarks.* Weight before operation was seven stones six pounds; has gained one stone eight and a half pounds. Patient was seen with Dr. Trevor Pritchard, Retford. In March, 1902, reported to be quite well.

Case 4.—March 6, 1901. Infirmary; Registered No. 1221. Female, aged twenty-eight years. *Symptoms and Description.* Symptoms of gastric ulcer for more than five years. Was under treatment at the beginning of illness at the infirmary. Had been gradually getting worse. Vomited now after every meal; pain and vomiting came on about from half an hour to one hour after food. Vomit was very "sour." On examination, hour-glass stomach. On distending with CO_2, the cardiac half increased considerably, forming a very large lymphatic area. The pyloric half distended but little; the division was clearly seen. On auscultation, a forcing, gurgling sound was distinctly heard. *Condition found at Operation.* An hour-glass stomach. The cardiac side of constriction was much dilated, and larger than a normal stomach. Rather beyond the middle of the organ was a constriction that would just admit the forefinger; around the constriction were much induration and many adhesions; especially noticeable was a thick, cord-like one coming from the liver. This was divided between ligatures. The liver was slightly torn on separating widespread adhesions along the lesser curvature. Below it, on each side, the stomach sagged, and between the cavities an anastomosis was made which readily admitted three fingers. (Gastrogastrostomy, gastrolysis.) Recovered. *Remarks.* March, 1902. Perfect result. Eats well and heartily, and has no discomfort. Patient seen with Dr. Waugh, Skipton.

Case 5.—March 9, 1901. Infirmary; Registered No. 1237. Male, aged fifty-five years. *Symptoms and Description.* Stomach troubles for sixteen years. At first pain after food and occasional vomiting. Five years ago an acute attack of hæmatemesis, melæna, and general swelling of the body, which it was feared might prove fatal (? perforation). No ease in the stomach since then; constant vomiting, pain after every meal, and great wasting. Now looked thin, pinched, and shrivelled. For three weeks had had no food, only sips of water and nutrient enemata. On examination dilated stomach. Free HCl. *Condition found at Operation.* Hour-glass stomach. At first it was thought to be a dilated stomach. On tracing the stomach toward the pylorus, an extremely narrowed isthmus—barely as thick as the little finger—was reached which was supposed to be narrowed pylorus; but on tracing beyond it, stomach was still found. On invaginating a finger

from each side of constriction, no opening could be felt. Many adhesions were separated until all was clear and free. Then incision into stomach or cardiac side of the isthmus, and a probe-director was passed through constriction, which it fitted snugly, the opening being no bigger than a No. 4 or No. 5 catheter. Gastroplasty was performed. On the pyloric side of the stricture was a column of mucous membrane forming a bridle stricture. This was ligated, divided at both ends, and removed. Recovered. *Remarks.* This patient was in the infirmary under Mr. Littlewood, and was operated upon by me in his absence.

Case 6.—April, 1901. Registered No. 1709. Male, aged forty-six years. *Symptoms and Description.* Symptoms for twelve months; pain, heaviness, discomfort after meals, loss of weight, and general deterioration in health. At Christmas had an attack of acute pain and hæmatemesis, and was very ill for several days; since then has never taken any food (solid or liquid) without pain. Has noticed on several occasions that the stools were "black as ink." Vomits now every day. *Condition found at Operation.* Two ulcers near the pylorus—one on gastric, one on duodenal side. A mass equal in size to a walnut found at the pylorus. Pylorus very narrow; adherent to liver and gall-bladder by dense bands. At the middle of a hugely dilated stomach a constriction that would admit four fingers. Posterior gastroenterostomy to pyloric pouch. At the post-mortem two ulcers (duodenal and gastric) were found, the former very adherent to the gall-bladder; the latter had perforated into a mass of adhesions, its base being partly formed by the pancreas. Died. *Remarks.* Sent by Dr. Crawford Watson, Harrogate. All went well for three days; then a large prolapse of rectum—from which he had previously suffered—came down during the night, and was not discovered for four hours. When I saw him the prolapse was livid and œdematous, and could not be reduced until ether had been administered. From this time patient became gradually worse; the temperature ran up to 104° and 105°, and he died four days later. The following is an abstract from the post-mortem record, written by Dr. Maxwell, Telling: "The stitches are quite sound, the opening good, and surgical technique perfect. No peritonitis. The hemorrhoidal and inferior mesenteric veins are full of disintegrating clot. (Septicæmia.)"

Case 7.—May 24, 1901. Registered No. 2413. Male, aged forty-eight years. *Symptoms and Description.* For many years has vomited after food. Pain comes on about one and one-half hours after food, and is eased by vomiting. In November, 1899, and May, 1900, had severe hæmatemesis. Three years ago was in the infirmary, and a diagnosis of "cancer" was made. On examination an irregular dilated stomach. On inflation a distinct notch seen in the lower border; just

above this a very loud, forcing, gushing sound heard. Hour-glass stomach diagnosed. Signs 1, 3, 5, and 6 present. *Condition found at Operation.* Hour-glass stomach. The cardiac pouch was much dilated, pyloric small and not dilated. The constriction was about three inches from the pylorus. At the upper border of the isthmus a hard mass, equal in size to a walnut, with puckering of stomach and lesser omentum. (Posterior gastroenterostomy.) Recovered. *Remarks.* Sent by Dr. Isaac Taylor. Weight before operation, eight stones two pounds. Weight, January 15, 1902, ten stones.

Case 8.—May, 1901. Female, aged fifty years. *Symptoms and Description.* Ailing many years, the symptoms dating from an illness in which "gastric ulcer" was diagnosed. A diagnosis of "hour-glass stomach" was made by Dr. McGregor Young. Signs 1, 3, and 6 present. *Condition found at Operation.* Hour-glass stomach; the isthmus being about two and one-half inches from the pylorus. The stomach and all the intestines were thin and translucent, and seemed almost devoid of muscle. On exposing the posterior wall of the cardiac pouch a second ulcer was seen. Posterior gastroenterostomy was performed. After the operation regurgitant vomiting of such severity and persistence that a second operation was undertaken, and the proximal and distal segments of the jejunal loop were united. (Jejuno-jejunostomy.) Recovered. *Remarks.* Patient seen with Dr. McGregor Young. The result of the operations has been most satisfactory; the patient is much better than she has been for many years.

Case 9.—June, 1901. Male, aged thirty-nine years. *Symptoms and Description.* Stomach troubles for nine or ten years. Then began quite suddenly to have great pain after food and to vomit two or three times a day; no hæmatemesis. The pain usually came on about one and one-half hours after food. Seen four years ago by a consulting physician, who diagnosed dilated stomach, and advised lavage, which has been done ever since. Relief at first very great, but lately a serious relapse and no relief from washing. Hour-glass stomach diagnosed. Signs 1, 2, 3, and 6 present. *Condition found at Operation.* Hour-glass stomach. The constriction just admitted the end of the forefinger, was situated about three inches from the pylorus, at a point where loud gushing sounds were heard before operation. The cardiac complement was enormous, the pyloric a little dilated. (Posterior gastro-enterostomy. Pylorodiosis.) Died. *Remarks.* Sent by Dr. Ellis, of Halifax. After the operation patient had suppression of urine. In four days secreted only eleven and one-half ounces, tinged with blood. Pulse became very rapid and of poor volume. Five pints of saline solution infused. Urine was secreted almost at once. Gradual improvement then for nine days; then suppression for forty-eight hours, and death.

Both kidneys diseased, the left small and granular and cirrhotic, the right granular. Operation area normal. The urine before operation had been frequently examined and nothing abnormal discovered.

CASE 10.—June, 1901. Female, aged twenty-five years. *Symptoms and Description.* For three years has suffered from vomiting, pain after food, inability to take ordinary diet. Has never vomited blood, but has seen vomit which "resembled tea." Vomiting now almost continuous. Has lost three stones in weight. On examination a hard mass above and to the left of the umbilicus. On distending the stomach with CO_2 a distinct swelling on each side of tumor. Hour-glass stomach clearly seen. *Condition found at Operation.* Hour-glass stomach. A large mass, about four inches in diameter, found at the junction of the two pouches, densely hard, immovable, and adherent firmly to pancreas. Several enlarged glands. Supposed to be malignant. Stricture between the two pouches dilated freely. Recovered. *Remarks.* Sent by Dr. Crawford-Watson, Harrogate. Weight before operation, five stones. Vomiting ceased at once, and food was freely, almost greedily, taken. The tumor quickly disappeared. Looks ruddy and well. Weight now, seven stones seven pounds.

CASE 11.—April, 1901. Male, aged forty years. *Symptoms and Description.* About six months ago was suddenly seized with acute, intolerable pain in the upper part of abdomen. Constant stomach troubles since; pain, weight, "dragging sensations." Has lost flesh quickly. On examination a smooth, globular swelling between mid-line above umbilicus and left costal margin. Soft and fluctuating. *Condition found at Operation.* The stomach was hour-glass shaped; the constriction was adherent to the anterior abdominal wall. On separating the adhesion the stomach was opened and gastroplasty was performed. The tumor pushed the stomach forward. The great omentum below stomach was torn through, and the finger passed into the lesser sac. A smooth globular cyst found projecting into the cavity and springing from the pancreas. Recovered. *Remarks.* Sent by Dr. J. Exley, Wortley. A pancreatic fistula remained until to-day, but is almost closed. Health and weight fully regained.

CASE 12.—July, 1901. Female, aged twenty-eight years. *Symptoms and Description.* Six years' history of increasing indigestion, dating from an illness described by the doctor as "ulcerated stomach." Pain comes on one hour after food, worse when lying on the right side. Vomits after nearly every meal. Is getting steadily thinner. Signs 1, 2, 3, 4, 5, 6, and 7 all present. *Condition found at Operation.* Hour-glass stomach and very tight pyloric obstruction. I performed gastroplasty and posterior gastroenterostomy into the distal pouch. Died. *Remarks.* Sent by Dr. Baxter-Tyrie, of Keighley. Death

from pneumonia on the fifth day. The anæsthetic was badly taken, lividity and rigidity of abdominal muscles being present throughout.

Case 13.—April 22, 1902. Female, aged forty-two years. *Symptoms and Description.* Chronic indigestion. The symptoms came on gradually; pain after food, vomiting, and constipation. Eighteen months ago had hæmatemesis, and since then the symptoms have been greatly increased. Signs 1, 2, 3, 5, and 6 present, and a diagnosis of hour-glass stomach made. *Condition found at Operation.* An hour-glass stomach—a perfect example. The constriction in the body admitted the little finger snugly. In the narrowed isthmus, on posterior surface, a densely hard, indurated area, at least three-quarters of an inch in thickness; the lesser and greater omenta both puckered up. Gastroplasty—a scar of the ulcer seen on mucous surface of posterior part. A very tight stricture found at the pylorus; the pyloric pouch being dilated also. Posterior gastroenterostomy from pyloric pouch. Recovered. *Remarks.* Dr. H. H. Greenwood. A very rapid pulse for four days after operation.

Case 14.—November 29, 1902. Female, aged twenty-seven years. *Symptoms and Description.* Nine years' history. Pain after food and vomiting were the symptoms first noticed. Soon all solid food caused pain, and was rejected. The food became "sour" and the gas belched up smelt putrid. On several occasions blood has been vomited. The signs and symptoms of hour-glass stomach were elicited and a confident diagnosis made. The two pouches of an hour-glass could be distinctly seen on inflation. Signs 1, 2, 3, 5, and 6 present, and an hour-glass stomach diagnosed. *Condition found at Operation.* An hour-glass stomach was at once exposed. But following my invariable rule, I traced the stomach up to the cardiac orifice and discovered another stricture and another pouch. There were thus two annular constrictions in stomach and three pouches. The first pouch was the largest, the pyloric the smallest, being only of the size of a lemon. Gastrogastrostomy and gastroenterostomy were performed. The stomach was scarred almost universally. Recovered. *Remarks.* Dr. Knowles, Newstead, Halifax. A most excellent recovery.

Case 15.—January 20, 1903. Female, aged thirty-four years. *Symptoms and Description.* Nine and one-half years ago vomited a "great deal" of blood. Dr. Mackenzie then diagnosed ulceration of the stomach. Since then has always been ailing—especially after a moderate meal. Five years ago was very ill; had acute abdominal pain, severe vomiting, and hæmatemesis. Was in Manchester Royal Infirmary, with "ulcer of the stomach." One and one-half years ago hæmatemesis. For several years had taken no solid food, and has never had an ordinary meal. Has lived on milk, custards, porridge. On exami-

nation an hour-glass stomach was diagnosed. Wölfler's two signs; paradoxical dilatation; increase in subcostal tympany; gurgling, rippling sound at left end of stomach, all well marked. *Condition found at Operation.* An hour-glass stomach and an hour-glass duodenum. Two large stomach pouches united by a narrow isthmus at the lesser curvature. Tight constriction at pylorus; the first portion of duodenum dilated to form a sac the size of a lemon; beyond this another constriction. The pyloric pouch of the stomach was more densely scarred than any stomach I have ever seen; its texture was almost wholly fibrous. On its posterior surface also many scars were seen. Gastrogastrostomy and posterior gastroenterostomy to the pyloric pouch. Recovered. *Remarks.* Dr. Mackenzie, Burnley. Within three weeks of the operation ate solid food heartily, and had taken all the vegetables in season.

DISCUSSION ON SURGERY OF THE STOMACH.

DR. W. W. KEEN, of Philadelphia.

We are very fortunate in having two representative men of Germany and England present at this meeting, especially as both Professor Mikulicz and Mr. Moynihan have done so much in this department of surgery. Professor Mikulicz's paper deals with subjects that in general I am not very familiar with. I have not seen any cases of spasm of the cardia which I have recognized. I was very much interested in his statement as to the method of diagnosis by the œsophagoscope. Last summer, when it was my pleasure to be present in Breslau, I was honored by Professor Mikulicz with a demonstration in two cases, and I was so convinced with the value of the method that I immediately provided myself with one of the instruments, which I have used three times. On one occasion I was not able to introduce it beyond the constriction caused by the cricoid cartilage. I inserted it in both of the other cases, and observed the condition of the œsophagus; but in only one could I detect the source of the trouble. This was probably due to the fact that I was a novice in the use of the instrument, and, therefore, awkward. I would like to call attention to an œsophagoscope made in Rochester, N. Y. In this instrument the light is at the internal end, and I think gives a better view than the one of Professor Mikulicz.

As to peptic ulcer of the jejunum, I have never observed any following gastroenterostomy. Such cases, I think, must be exceedingly rare. You will note that five of the fifteen reported by Professor Mikulicz were seen by himself, but then Breslau is one of the places where the largest number of operations upon the stomach are done. I have never seen so large and difficult a case of intussusception as he reports.

Mr. Moynihan's results are most creditable. I do not think I have been more interested in any cases for a long time than I was in those reported in his paper. They reminded me of two cases of my own, one of which I mentioned in my Cartwright Lectures some years ago. It was that of a young woman, who was suddenly seized with a violent hemorrhage, and later had others, losing each time over a pint of blood. She hovered between life and death some time, and was never strong afterward. The final history, which was not told at the time of the Cartwright Lectures, has since unfortunately ended in death. She had recurring hemorrhages again and again until she died. The point that I wish to make is that radical surgery of the stomach is less dangerous than the continued action of the disease. I should have made a gastroenterostomy, which would probably have saved her life.

The second case occurred about a month ago in a man who was a waiter in a restaurant. He was in vigorous health, when he was suddenly

seized at 3 P.M. with excessive pain in the abdomen. He was brought to the hospital, and by 7 P.M., as there was an increasing leucocytosis, he was operated upon immediately, and perforation of a gastric ulcer was found. He made an uninterrupted recovery. I mention the case because it was in a man who was neither chlorotic nor anæmic, and who had never had the slightest premonitory symptom of gastric ulcer.

DR. W. J. MAYO, of Rochester, Minn.

Professor Mikulicz has so long led the way that the rest of us have become used to following him. I have had one case of cardiospasm to add to his list of cases, in which I did a gastrostomy and fed through the fistula for five months. The rest cured the condition, the patient being well one and a half years later.

As to Mr. Moynihan's reference to chronic ulcer, and especially as to his curing them by gastroenterostomy, my experience is that if we operate by this method the patients will improve at once, and most of them remain well; but, unfortunately, there is a certain class in which this improvement does not remain permanent; and the question is, In what way does gastroenterostomy fail to cure? In doing gastroenterostomy the complete rest is the most important feature, and the ulcer heals. When the relief of the irritation becomes sufficient to check the pyloric spasm and allow the food to pass through the pylorus normally, if there be no organic obstruction there is a tendency to contraction at the fistulous opening, and, as a result, there is renewed irritation, reopening of the ulcer, and failure to permanently cure, or, in some cases, the double drainage makes trouble. In twenty-eight cases in which the pylorus was unobstructed, I had eight reoperations, and in every one there was distinct contraction of the gastrointestinal fistula. In considerably over 100 cases in which there was pyloric obstruction there was no contraction at the anastomosis or return of symptoms from this cause. If the pylorus is permanently obstructed there will be no contraction of the gastrointestinal fistula, and permanent cure can be expected. For ulcer without obstruction, if we do a pyloroplasty we shall, perhaps, get relief; but obstruction at the pylorus is by no means necessary to the formation of an ulcer, as ulceration may and does take place in the duodenum beyond the possibility of obstruction; and, in spite of the increased size of the outlet, the food must pass through the diseased area.

In ulcer of the stomach without contraction at the pylorus, excision of the pyloric end of the stomach, as advised by Rodman, would appear to be the best operation. It would remove all danger of recurrence or secondary carcinoma. Gastroenterostomy should be reserved for the cases with obstruction at the pylorus and dilatation.

Dr. Tiemann, of Leipzig.

I thank you for your very cordial reception, and hope you will excuse my pronunciation. I have a great feeling of admiration for the American Surgical Association and a desire for our united work for scientific and practical accomplishment. Science and art are international, and are separated neither by politics nor countries. The physicians and surgeons of America and Germany are fighting many diseases for the preservation of the public health, and it seems to me that in working for humanity we are doing the right thing. He who works for the benefit of mankind works best, and we are all finding our greatest happiness in helping those most in need. Surgery has made such remarkable progress during the past twenty years that the surgeon can operate most successfully upon every organ of the human body. I hope that the American and German physicians and surgeons will always be to the front in this scientific work for the public good. In Germany we have a great feeling of sympathy for the United States.

I again thank you very much for your cordial reception on this, my first visit to America. I have often intended to come, but was never before able to find the time. I have found so many friends and seen so much kindness that I cannot thank you enough. May the American Surgical Association ever continue to prosper, and the next time I visit you I hope to read a paper.

Dr. William L. Rodman, of Philadelphia.

I very much enjoyed the papers of our distinguished friends, and consider we are under great obligations to them. I feel under a personal obligation, because I have recently witnessed Mr. Moynihan operate. He has made a most excellent plea for gastroenterostomy, and has had such elegant results in all his cases, for I remember his house surgeon told me that they practically all got well. However, I feel that the tendency at the present time is to cling almost too much to this operation, and to look upon it as an operation that will cure almost all diseases of the stomach. It should be preferred in operations for acute hemorrhage of the stomach where it is impossible to find the bleeding point, but there are cases where it has failed. Professor Kocher has reported some cases, and there can be no doubt that it does not always produce the very best secondary results. We must take a step further and do something more.

I was very much interested to-day in Professor Mikulicz's paper, and he makes it clear that not only may hemorrhage take place, as well as other secondary complications, but also states that secondary ulcera-

tion of the duodenum may occur. Considering the fact that so many of these cases have failed to be cured by gastroenterostomy, it would seem to me we must go further. The medical men have shown very clearly that the mortality in gastric ulcer is not less than 25 per cent., and six per cent. of all gastric ulcers are followed by death from perforation, while 8 per cent. die from hemorrhage. Many degenerate into the epithelium, while in others adhesions take place. It would seem better to operate than to treat medically. When you do an operation in acute hemorrhage you do one in which there is a mortality of 40 per cent., while in perforation the mortality is more than 50 per cent. One should operate upon these cases before these complications have taken place; and if these ulcers can be reached and excised safely, as they can in most instances (as they are almost always limited to the pylorus and can be very safely removed), it seems to me a better operation is a pylorectomy or a partial gastrectomy. By this means you would get away with some of these fatal complications. At New Orleans last week I took part in a similar discussion, and Dr. Mayo agreed with me. It is as safe as the medical treatment of gastric ulcer, and the early mortality by partial gastrectomy has been only 15 per cent. If this be true, surely, with the improvements that have taken place in our surgical methods, we can reduce this to 10 per cent.

Dr. Leonard Freeman, of Denver, Col.

I desire to mention a case of gastroenterostomy for ulcer of the stomach in a young man between twenty-five and thirty years of age. He had bled very profusely, almost to the point of exsanguination. After doing an anterior gastroenterostomy with the Murphy button, the hemorrhage stopped and he regained sufficient strength to return to work. Several months afterward the bleeding recurred, and he succumbed during an acute hemorrhage. It can be inferred from this that gastroenterostomy does not always produce favorable permanent results.

Dr. J. M. T. Finney, of Baltimore.

In my opinion, in cases of hemorrhage rest is a thing that is needed, and if we can secure this, by whatever method, we will, at any rate, relieve two of the principal reasons for the continuance of the hemorrhage. Mr. Moynihan said that dilatation brings about repeated hemorrhage; but if we have good drainage and physiological rest we can expect, in most cases, a relief from hemorrhage. In many of the operations we do not make a sufficiently large opening, and this is particularly true in pyloroplasty, which is its principal objection. If we can

secure good drainage at the most dependent portion we shall have a great advantage, and particularly if we can secure that drainage at the proper point—*i. e.*, at the natural place—we shall have a better operation than gastroenterostomy could ever be. It has objections, of course, which are inherent in the operation itself. It puts the opening where it is not naturally—away from the opening in the pylorus, which is not the best place for it. Gastroenterostomy does not always give satisfactory results, and in one case I did a pyloroplasty where gastroenterostomy had already been performed. I have a case waiting for operation in which a gastroenterostomy has been performed twice without benefit. We can give physiological rest by making the opening large enough, which is a point I was especially interested in, and attention has not been directed sufficiently to it.

Dr. Louis McLane Tiffany, of Baltimore.

I was very sorry to miss hearing the papers in full, and I heard only the last part of Mr. Moynihan's; but I wish to call attention to the fact that what he has said in reference to dyspepsia not being a medical disease is very true, as I agree with him that in many cases it is distinctly a surgical one. I mention that form of dyspepsia which is not due to disease of the stomach at all, but rather to disease of the liver or adjacent organs where adhesions have formed. Peristalsis is not thoroughly carried out in these cases, while absolute relief will be secured by separating adhesions. A test meal will show a marked deficiency of acids, but there is no evidence of any hemorrhage of the stomach having occurred. I think the adhesions which are found so very frequently about the stomach have something to do with the non-relief of stomach digestion by gastroenterostomy, and consider it a necessary part of any stomach operation that the adhesions should be freed and that the stomach should be put in as capable a condition as possible for carrying out such movements as are necessary for proper digestion. In many cases these adhesions are the sole cause of the dyspepsia, and it has always been my habit when operating upon the stomach to free all adhesions around it. More than once I have opened the stomach for supposed disease and found it quite normal, but with adhesions to some adjacent organ, the freeing of which gave relief at once.

Dr. N. B. Carson, of St. Louis.

I wish to take exception to Dr. Mayo's remark as to the opening between the stomach and the intestines remaining patulous. I have had personal experience with two cases, both malignant and both operated upon in the early days of stomach surgery. In the first case

I operated for cancer of the pyloric extremity, and the symptoms were at once relieved, but the patient died from the disease and from a return of the symptoms. At the post-mortem we found that the opening had almost entirely closed, and was so small as hardly to admit the tip of the little finger, although I had made a very free opening. The second case can hardly be considered, the disease having extended and involved the opening. I have heard reports from others who have done anastomoses for malignant disease, and have had opportunities of making post-mortems, and they have reported that the openings have been almost entirely closed.

Besides the cases above referred to I have had opportunity of seeing the same results follow intestinal anastomoses in dogs; and while the anastomoses have been confined to the intestinal tract below the stomach, I cannot see why the same results should not obtain here as well as in the stomach. Therefore, I do not believe the statement that the opening will not close is altogether correct.

Dr. B. Farquhar Curtis, of New York City.

Professor Mikulicz has spoken of the examination of the œsophageal end of the stomach from above, but it is possible to view this part of the organ from below, as was proven in a case of mine of cicatricial contraction of the œsophagus, situated very low down, which almost closed its cardiac end. The patient was a girl, aged nine years. The stomach was opened, the stricture having been impassable. A cylindrical speculum was introduced, and I got a good view of the œsophageal end, where I found an extensive cicatrix. With a probe I found the entrance to the end of the œsophagus, and passed a bougie upward with a cord attached. The operation resulted in curing the stricture.

As to hemorrhage from the stomach, I would like to mention one case of a woman who was exsanguinated from a hemorrhage. On opening the stomach I could find no source of the hemorrhage until I had searched the whole organ. I then discovered a minute erosion, but no vessel which could be seized and controlled by ligature. Feeling the stomach on the outside opposite the erosion, I found a large artery directly under it. I at once passed a silk suture around it, including only the artery and peritoneum, and controlled the hemorrhage. This method could be used with safety, provided the vessel is not tied too far back near its origin. In this case the artery was a large branch of one of the arteries half-way between the greater and lesser curvatures.

I do not believe it is possible with the naked eye to make a diagnosis between malignant disease of the stomach and ulcers with thickened bases, but this must be done by the microscope. My reason for this remark is based upon two cases of my own, which had been treated for

years by washing out the stomach. The ulcer was in the centre of a large mass, and appeared so dangerously like cancer that I excised it, resecting one-third or one-quarter of the stomach with the pylorus. I closed the end of the stomach and united the duodenum with the jejunum (Kocher's method).

In both of these cases I obtained a cure—it is now three and a half years since operation—and each was shown by the microscope to be a typical carcinoma.

Mr. Moynihan. I am very grateful to those who have taken part in this discussion for the kindness with which they have greeted my paper. I think there is one point which requires special emphasis at the present moment. It is that the geography of gastric ulcer has yet to be written. There are certain differences between the kind of case seen here and that seen at home; perforation and hemorrhage, for example, are not as common here as with us. The implantation of malignant disease is, on the other hand, more common on this side. Although I have devoted considerable time to the examination of museum specimens of carcinoma, I have only been able to satisfy myself that malignant disease has been implanted upon chronic ulcer in one case.

As to the treatment of hemorrhage by gastroenterostomy, it seems to me that it is as likely as any other treatment to arrest the hemorrhage. It is the distention of the stomach that is the cause of the hemorrhage. Several have reported cases where they have opened the stomach for hemorrhage, and, after discovering the supposed bleeding point, have excised it; but the hemorrhage has gone on just the same, and the patient has died. Since I lost the case in which I had searched for and excised the ulcer, I have in all cases ignored the ulcer and have at once performed a gastroenterostomy. My patients have been as ill as any I have ever seen on an operating-table—I have, indeed, never seen a patient put upon the operating-table in such a seemingly hopeless condition as was present in one of the cases of duodenal ulcer quoted in my table (case of member of Parliament operated upon October, 1902).

Another point which was raised by Dr. Mayo is that, when the pylorus again becomes competent as the result of the healing of the ulcer, the gastroenterostomy opening tends to close; but I cannot say that I agree with him in this. I am inclined rather to believe that the differences are due to differences in technique. I have myself done gastroenterostomy in three cases in which it had previously been done, one with the Murphy button and two with the La Place forceps. In these three cases the symptoms recurred, and I did the operation that I now practice. The patients are perfectly well, and there has been no recurrence of any of the symptoms.

Dr. Rodman's suggestion that the whole of the ulcer-bearing area should be excised is a good one, and it strikes me as being of the very first importance. The mortality in early cases need not be more than 5 or 10 per cent., and the cure would be complete. Further thought will have to be given to the matter, but my present view is that in this suggestion there is much that is deserving of careful consideration.

That there will be great improvement in the treatment of these cases in the future does not admit of doubt. When our mortality is as low as 3 or 5 per cent., with the patients as ill as some of those in my list, it is not too much to expect that, if the cases can be secured early, a mortality of 2 per cent. will not be exceeded, and those appalling catastrophies, perforation and hemorrhage, will often be forestalled. May I, in conclusion, express my sense of gratitude to all those who have listened to my paper for the cordial welcome which they have given me.

Dr. von Mikulicz. I enjoyed Mr. Moynihan's paper very much, and agree with his conclusions; but I did not understand whether he makes his gastroenterostomy anteriorly or posteriorly. I am against the anterior gastroenterostomy in benign affections of the stomach, especially in ulcer, because of the danger of a peptic ulcer of the jejunum. In my opinion, in a case of acute hemorrhage gastroenterostomy alone is not sufficient. We in Germany do a combination of gastroenterostomy with jejunostomy. The gastroenterostomy gives drainage, while the jejunostomy is to feed the patient for from six to ten weeks. This is then allowed to close, and I consider this the operation of the future.

THE X-RAY AS A THERAPEUTIC AGENT IN CARCINOMA.

By ARTHUR D. BEVAN, M.D.,
CHICAGO.

Although during the last year a considerable quantity of evidence has been added confirming the value of the X-ray as a therapeutic agent, nothing strikingly new has been discovered. However, we are, I believe, somewhat better able to estimate the value and limitations of the agent. The facts which are to-day fairly well established are the following:

1. The X-rays will destroy the epithelial cells of carcinoma superficially situated, as in epithelioma. The X-ray seems to have a selective action on the epithelial cells of carcinoma, due probably to their possessing lower resisting powers against the agent than that possessed by normal epithelial cells. When superficially situated so that the furthest cells are within a centimetre of the surface, a mass of carcinoma melts down under the X-ray, the individual cells dying become granular, and are absorbed without gross evidence of necrosis or of tissue change beyond that of reddening of the surface and the so-called X-ray reaction. Sometimes, however, where a large mass of carcinoma is attacked, it may soften and break down and be separated from the normal tissues, something like the breaking down of a gumma.

When the carcinoma is very thin and very superficial, as an epithelioma of the face of the rodent ulcer type, not yet involving the tissues underlying the skin, the disappearance of the lesion and the restoration of the surface to almost normal, with slight evidence of scar tissue, can confidently be looked for after about twenty exposures of ten minutes daily or every other day with soft tube, 110 volts and 2 ampères.

When the epithelioma is a thick mass of new tissue, as an epithelioma of the lower lip as thick as the finger, the X-ray will produce extensive change, with destruction of many of the carcinoma cells, and sometimes of all of them, with resulting cure. Frequently, however, even under the treatment the process will extend and the lymphatics become involved.

In recurring carcinoma of the breast, with recurrence in and about the scar, with nodules in the skin and immediately beneath this, the X-ray will produce an absorption of the masses even of considerable size—the size of an English walnut. If these masses are the only locations of carcinoma in the body, a cure might be hoped for with their disappearance; but, unfortunately, with these masses are usually masses in the mediastinal and other lymph glands, and, in spite of the disappearance of the skin masses, the patient goes on to death from general carcinomatous invasion, apparently, however, being benefited both locally and generally by the treatment.

In cases of deep-seated carcinoma, such as stomach, larynx, superior maxilla, mouth, etc., I have seen no evidence of benefit beyond the statement of the patients that they felt better, had less pain, etc., some improvement in general condition. In every case the lesion extended, and in none was a cure obtained.

In estimating the value of the X-ray in the treatment of carcinoma there are three facts which must be especially considered, and which seem to control largely the results:

1. The situation of the lesion, whether superficial or deeply situated.

2. The rapidity of the growth of the cells, and the resisting power of the carcinoma cells in the particular case.

3. The size of the new-growth.

In regard to the first, the destructive action of the X-ray on cancer cells is in direct proportion to their superficial position—*i. e.*, the more superficial the greater the destructive effect; the deeper, the less the destructive effect. The depth at which the destructive effect of the X-ray on cancer cells, with our present technique, can be with any confidence expected does not seem to

greatly exceed a centimetre. In regard to the vitality of the cancer cells in the particular case, I think it is quite clear that the cancer cells differ markedly in different cases in regard to their resisting power to the X-ray. The rapidity of the growth seems to be a fair index of their resisting power to the X-ray, the very slowly growing cancer having less and the rapidly growing greater resisting power. Depending on the differing resisting power and the superficial or deep situation, some lesions disappear under the X-ray treatment, some remain stationary, and some continue to grow even while under treatment, apparently unaffected by it. The size of the lesion is of importance, and the value of the X-ray varies in inverse proportion to the size of the growth; the smaller the growth the more evident the effect; the larger, the less effect. A small superficial epithelioma is readily destroyed; a thick, large, epitheliomatous mass with difficulty or not at all by any amount of the agent which it is permissible to employ, and even though many of the cells in such a growth may be destroyed, enough remain to bring about regional infection, which may become evident even during treatment.

The question which has been asked—*i. e.*, whether under some circumstances the X-ray stimulates the growth and dissemination of the cancer cells—is one which it is at this time difficult to answer. Personally I have seen no evidence of this. I have seen, to be sure, cases of cancer grow with great rapidity, and widespread dissemination occur while the cases were under treatment; but we see the same thing happen frequently in cases which are not under any form of treatment, and I have interpreted the cases when rapid growth occurred while under the X-ray treatment simply as being cases which were not influenced in any way by the agent, and believe that the same rapid growth and dissemination would have occurred with or without the X-ray treatment.

What should be one's position in regard to the use of the X-ray as a therapeutic agent in carcinoma?

It is, I believe, the treatment of choice in slowly growing superficial epitheliomas—the rodent ulcer type—especially those of wide extent without regional involvement, and especially lesions

of this kind situated about the face and eyelids where a radical removal of the lesion with the knife would result in marked disfigurement and deformity from the resulting scar, even when skin grafting is employed. In all other forms of carcinoma where the lesion is of rapid growth or more deeply situated than the skin, or even when limited to the skin is of considerable thickness, the case should be treated by extirpation and followed by a course of X-ray treatments—probably, as a rule, about twenty exposures immediately after the healing of the operative wound.

I think that this position—this combination of the knife and the X-ray—is logical on the following grounds:

1. With the exception of the carcinomas of the rodent ulcer type above described, little can be expected from the X-ray in the treatment of primary carcinoma. Therefore, no time should be lost with its use; and, where conditions warrant, the carcinoma should be widely extirpated in accordance with approved surgical methods.

2. As has been repeatedly shown—especially in cases of breast amputation for carcinoma where recurrence has taken place in and about the scar—these secondary masses can be made to disappear with the use of the X-ray. There can be but little doubt but that these secondary nodules—masses of epithelial cells the size of a bean or walnut—were at the time of the operation very small collections of cancer cells, which gradually grew from microscopic to macroscopic proportions; and it is reasonable to suppose that if the X-ray can destroy these bean-sized and walnut-sized cancer masses it could much easier have destroyed the microscopic masses of cancer cells from which they developed. I believe, therefore, that we should give this postoperative X-ray treatment a thorough and extended trial in our carcinoma cases, and believe that we shall considerably increase our number of permanent cures after cancer operations by this means.

The most interesting question to my mind in connection with the action of the X-ray on cancer cells is this: Would it not be possible in some way to so extend the action of this agent, which has the power of destroying cancer cells under certain conditions

—that is, at certain depths and cells of certain resisting powers—to a point where it can destroy them under all conditions? The fact that under certain circumstances (as Hodgkin's disease and lymphatic leukæmia) the X-ray does produce effects on masses of cells of low resisting power at great depths might encourage us to hope that under certain favorable conditions it might affect cancer at great depth.

Of course, if this could be accomplished our cure for carcinoma would be found. As it is to-day, the X-ray as a cure for carcinoma as we have seen, has a very limited field. In answer to this question, I have thought that the desired result might be accomplished in one of two ways, or possibly both: first, that physicists might so improve our X-ray apparatus that we could obtain the destructive effect on the cancer cells at all depths and yet without too great danger to the intervening tissues; and, second, that it might be possible to so diminish the resisting power of the cancer cells by some means—as, for instance, some chemical agent introduced either into the general circulation or locally injected—that even with the X-ray as at present developed we might obtain destructive effects at greater depths. In connection with this last proposition my mind naturally turned to iodine and arsenic as the agents which have shown evidence of power to affect deep-seated masses of new cells of low vitality, as iodine in syphilis, actinomycosis, and blastomycosis, and arsenic in malignant lymphoma, Hodgkin's disease.

In working out this idea we have some experiments to determine the effect of the X-ray on solutions of iodide of potash—to determine whether it would produce any chemical change and set the iodine free.

The first experiment was simple and interesting in its results. We took a solution of starch and iodide of potassium, and submitted it to a ten minutes' exposure of the X-ray, such as we used for therapeutic purposes. We had control solution under the same conditions minus the X-ray. It was found that the X-ray liberated about twice as much iodine as was liberated from the control solutions.

We have under way a series of experiments with the effects of iodide of potash and the X-ray on micro-organisms of varying resisting power; and although we have obtained some interesting results, they have not been constant, and we are not as yet in a position to make a final report.

After all, however, the clinical test of such a therapeutic scheme is the important test, and we have employed this mode of treatment—which, I think, should be called radiochemic therapy—in a number of cases. The two most striking cases of benefit from this method of treatment have, however, not been in carcinoma, but in other conditions—one a case of actinomycosis of the neck, which cleaned up surprisingly rapidly under the X-ray and iodide of potassium; and the other a tumor of the colon, of uncertain pathology, but almost certainly tuberculous, which has almost disappeared under the same treatment. In our carcinoma and sarcoma cases we have combined with the X-ray either iodide of potassium or arsenic; and although I have been encouraged by the results, the cases are too few and the difficulties in the way of determining the value of this combined treatment are so great that it is impossible at present to draw conclusions. I have, however, no hesitation in presenting this suggestion of radiochemic therapy, with the hope that others may be sufficiently interested to investigate its possibilities.

This line of thought is a very interesting one to me, although, like most such day-dreams, it may prove barren of result. It does seem plausible, however, that given an agent that will destroy carcinoma cells, and not the cells of the surrounding tissues, under certain favorable conditions for its action—*i. e.*, superficial situation and low-resisting power of cancer cells—it is quite possible we may find some way to enhance its action so as to reach cancer cells at all depths and of all degrees of resisting power, and secure in this way a carcinoma cure.

In conclusion, the X-ray at present is indicated as a therapeutic agent:

1. In the superficial epitheliomas above described.
2. As a postoperative treatment in most of our carcinoma cases.

3. In our inoperable cases, as a justifiable piece of experimental work, in the hope that this line of investigation may possibly lead to valuable results.

The dangers of the X-ray as a therapeutic agent are two, and these dangers should be especially pointed out to the general profession. The first danger is the possibility, in all cases, of producing an X-ray burn. This possibility can be reduced to a minimum by a thorough understanding of the technique, but cannot be entirely done away with, as burns will occur even in the hands of experts of the greatest experience. The second danger —and the most important one—is the using of the X-ray in cases where it should not be used, where its use is of no benefit to the patient, where its use means valuable time lost, where its use prevents the patient receiving the greater chances of cure offered by radical surgical removal of the disease.

FURTHER OBSERVATIONS ON THE INFLUENCE OF THE ROENTGEN RAY UPON SARCOMA.

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In a paper read before the American Surgical Association a year ago I reported ten cases of inoperable sarcoma treated by the X-rays. This was necessarily a preliminary report, since in no case had more than six months elapsed from the beginning of the treatment. Inasmuch as the X-ray treatment of malignant tumors, especially of sarcoma, is still in the experimental stage, every additional case is of interest.

From February 1, 1902, up to the present time, May 11, 1903, I have treated or had under my direction at the General Memorial Hospital 36 cases of inoperable sarcoma.

Anatomical classification of these cases gives:

Neck	4 cases.	Pectoral region	3 cases.
Neck and rib	1 case.	Femur	2 "
Parotid	3 cases.	Thigh	3 "
Superior maxilla	3 "	Abdomen	4 "
Orbit	2 "	Buttock	1 case.
Frontal sinus	1 case.	Buttock and ischium	1 "
Back	2 cases.	Testis	2 cases.
Skin, back, and face	1 case.	Ribs and kidney	1 case.
Skin	1 "	Ribs and hand	1 "

Pathological classification shows:

Round-celled	21 cases.	Melanotic sarcoma	1 case.
Spindle-celled	6 "	Osteosarcoma round-celled	1 "
Mixed-celled	2 "	Type of cell doubtful	5 cases.

In four cases, all of which were reported before this Association a year ago, the tumors entirely disappeared. Yet in every case there has since been a recurrence. A fifth case, at first supposed to be sarcoma, but which proved to be extensive tuberculosis of

the axillary and pectoral region, entirely disappeared under six months' treatment. Some of these cases are so very important that a brief history will be given:

Case I. *Extensive Recurrent Round-celled Sarcoma of the Neck, Both Sides, Superior and Infraclavicular, Pectoral and Axillary Regions on One Side, and Mediastinal Glands.*—The early history of this case is given in full in the Transactions of the American Surgical Association, 1902. The patient, M. A., aged forty-five years, was confined to bed and in such a hopeless condition that she was not expected to live more than two months. The toxins had been used with improvement at first, and finally abandoned. On February 10, 1902, at the General Memorial Hospital, I began the X-ray treatment purely as an experiment. The improvement was more striking and rapid than in any other case that I have observed. The tumors steadily disappeared, and by July 1st there remained only a small nodule, the size of an almond, anterior to the sternomastoid muscle. This I removed under ether purely for pathological study, and the examination by Dr. George P. Biggs, of the New York Hospital, confirms the original diagnosis, and is of great interest. The patient has regained her normal strength, and spent the summer in the country. She returned on September 24th with a local recurrence, the size of an English walnut, in front of the ear in the lower portion of the parotid. Both groins were filled with multiple tumors, varying in size from a hen's egg to that of a pigeon's egg. In addition, there was an intra-abdominal tumor, the size of two fists, smooth, globular, fairly movable, apparently originating in the ascending colon or its mesentery. There was undoubted constriction of the bowel at this point. Her condition again seemed hopeless. I resumed the X-ray treatment, and in three weeks the nodule in the parotid region had entirely disappeared, and the groin tumors diappeared within six weeks, and the growth in the abdomen has decreased to about one-half its former size.

April 13, 1903. The abdominal tumor is steadily decreasing and the patient's general health is good.

CASE II. *Small Round-celled Sarcoma of the Pectoral Region.*—E. M., aged thirty-five years. Family history good. Had been twice operated upon for round-celled sarcoma of the right pectoral region by Dr. Maurice H. Richardson, of Boston, and a microscopic examination made by Dr. W. F. Whitney at the Massachusetts General Hospital proved the growth to be round-celled sarcoma. The last operation was performed in October, 1901. The disease then involved the pectoral and axillary regions so widely that it was impossible to make a complete removal. Amputation of the upper extremity was considered, but not thought advisable. The patient was referred to me by Dr. Richardson in October, 1901. The mixed toxins were administered five to six times a week for three months in doses sufficient to produce a marked reaction. The tumor softened, and in January, 1902, a spontaneous opening occurred, with evacuation of about a pint of necrosed tumor tissue, as a result of which the growth was reduced about two-thirds. In February, 1902, the X-rays, plus toxins, were administered, causing continued decrease in the size of the tumor. In June, 1902, the growth had entirely disappeared, and the patient returned to Massachusetts in good condition. He worked hard every day and gained twenty pounds in weight. An examination, January 5, 1903, showed the patient's general condition still perfect, but about two inches below the clavicle, in the pectoral region, there was a small movable nodule the size of a hickory-nut. He returned to the General Memorial Hospital on February 3, 1903, for the combined toxin and X-ray treatment, with the result that in six weeks the recurrent tumor had again disappeared, his general health remaining perfect.

This patient has kindly come to the meeting, and I am happy to be able to give you an opportunity to make personal examinations.

CASE III. *Small, Round-celled Sarcoma of the Back.*—W. J., aged eight years; family history good. In the latter part of August, 1901, the patient fell from the stoop, striking his back. Two or three weeks later the mother noticed a swelling over the left scapular region, which increased in size rather rapidly. It was soft and

fluctuating from the start. The patient was referred to me in December, 1901, by Dr. Polhemus, of Nyack, N. Y. Physical examination at that time showed a cystic swelling the size of an orange in the left scapular region. The skin was normal, the tumor fluctuating, situated apparently just beneath the skin and superficial fascia. With a small trocar several ounces of blood were withdrawn. The diagnosis of hæmatoma was made, and on January 12 an incision was made under ether anæsthesia. About half a pint of fluid blood with some clots was evacuated. There was no evidence of any tumor at that time. The wound was closed without drainage, and healed by primary union. Two to three weeks later the tumor slowly began to re-form; it was still cystic in character, but increased steadily in size until, on May 6th, it had become about one-third larger than prior to the first operation. A second operation was performed. This time, in addition to fluid blood and clots, there was a slight thickening of the walls of the cyst, which made me suspect sarcoma. A portion of this thickened tissue was removed and examined by Dr. H. T. Brooks, Professor of Pathology at the Post-Graduate Hospital, who pronounced it small, round-celled sarcoma. Two weeks after the operation, before the wound had entirely healed, the X-ray treatment was begun and continued two to three times a week during the entire summer, with the result that by October 1st the growth had entirely disappeared. In the middle of October he was taken with an attack of scarlet fever, which confined him to the house for eight weeks, during which time he had no treatment. I did not see him again until early in December, when there was a well-marked local recurrence about the size of a hen's egg. The X-ray treatment was again advised, but carried out very irregularly, as the boy lived out of town. In January regular treatment was begun three times a week, by Dr. Raymond, of New Rochelle, and pushed to the point of causing a slight dermatitis. Yet, in spite of this, the growth has shown an increase rather than a decrease in size. January 20, 1903, I excised the tumor. X-ray treatment has been given twice a week since operation, and the boy whom I examined May 11, 1903, is still free from recurrence.

CASE IV. *Round-celled Sarcoma of Femur Involving the Lower Two-thirds of Shaft.*—A. G., aged nineteen years. A swelling was first noticed in the lower portion of the femur in November, 1901. This gradually increased in size, being accompanied by loss of weight and deterioration of general health. Physical examination on February 5, 1902, showed a large tumor extending from the condyles of the left femur to the junction of the middle and upper third. There was a fusiform enlargement of the entire lower two-thirds of the femur. On the outer aspect of the thigh, about one and one-half inches above the joint, there was a soft, fluctuating area just covered by thin and reddened skin. There was slight impairment of the functions of the joint itself. An incision was made under ether into the fluctuating area, and two to three ounces of clear serum, similar to that which is found in cystic degeneration of sarcomatous tissue, was evacuated. A curette was passed into the cavity of the bone and typically sarcomatous tissue removed. Microscopic examination by Dr. E. K. Dunham showed it to be a round-celled sarcoma. The patient absolutely refused amputation at the hip, which I strongly advised.

The X-ray treatment was tried entirely as an experiment, four exposures a week being given for a month, at the end of which time the circumference of the tumor had decreased one inch. The treatment was discontinued for two weeks, during which interval the tumor had again increased nearly an inch. The treatment was resumed, and at the end of another month the circumference of the thigh over the centre of the tumor was one inch less than the original measurement. The treatment was continued the entire summer up to December, 1902. At this time the measurement of the left leg was the same as that of the right. There was still some thickening in the lower part of the femur. The old sinus, which had never healed after the exploratory incision, was enlarged under ether and carefully curetted. Examination of the tissues failed to show any trace of sarcoma. The patient had gained twenty pounds in weight, but toward the end of December again began to lose in weight.

During the following six weeks the patient lost about twelve pounds in weight, and while the leg showed no increase in size, there was slight evening rise of temperature, suggesting possible metastases. A careful physical examination, made January 21, 1903, showed a metastatic tumor about three inches in diameter in the left pectoral region, freely movable and apparently situated between the muscle and superficial fascia. There was also a small, deeply situated mass in the lower dorsal region just to the left of the spinous processes, and apparently continuous with a mass in the left iliac region.

February 4, 1903, the tumor in the pectoral region was removed under ether anæsthesia, and was found to be a highly vascular typical round-celled sarcoma. Since February 10, 1903, the patient has had combined X-ray and toxin treatment, and the mass in dorsal and iliac region has greatly softened, and necrosed tumor tissue has been withdrawn by aspiration, and later an incision was made and a large drainage tube inserted. The patient's condition, July 18, 1903, is very good.

Inasmuch as a detailed history of the other cases has just been published in the *Medical Record*, March, 1903, it is unnecessary to repeat the same here. I wish merely to refer to a few of the cases that are of special interest:

A most striking case of partial disappearance of an undoubted sarcoma of the neck is that of a Mr. S., aged thirty-six years, who has been under three weeks' treatment at the General Memorial Hospital for a (probably round-celled) sarcoma of the orbit, with extensive involvement of the cervical glands on both sides of the neck. Entire duration of the disease had been only eight weeks.

Previous to his admission to the General Memorial Hospital the patient had been at the Eye and Ear Infirmary for a week, under the care of Dr. Kelly. His condition was considered utterly hopeless, and he was so weak that he could hardly get about the ward. In view of the very rapid progress of the disease,

it seemed to me that there was little use in attempting anything in the way of treatment; but, at the urgent request of the family, I put him on the combined treatment with the toxins and the X-rays. The X-ray has been given four times a week, and he has had very large injections of the toxins—interstitial, remote from the tumor—into the chest, taking as much as twenty-eight minims without chill—a very unusually large dose. The photographs taken before and two weeks after treatment show the remarkable effect upon the tumors in the neck. There is very little decrease in size of the growth in the orbit, and I intend, in the near future, to enucleate the eye. His general condition has improved very markedly.

While no microscopic examination has been made in this case, there is no reasonable doubt that we have to deal with a round-celled sarcoma, primary in the orbit.

[NOTE.—Two weeks later the eye and tumor of the orbit were removed. Microscopic examination showed the growth to be a round-celled sarcoma. The toxins and X-ray were continued after operation. July 1, 1903, there has been a slight return in the orbit, but the neck still remains free.]

Melanotic Sarcoma of the Iliac Glands.—Mrs. N., aged thirty-seven years. Five years ago a small, primary, melanotic sarcoma was removed from the skin in the region of the ankle. There was no local recurrence, but she has had five subsequent operations for recurrent growths in the femoral and iliac glands. I began the X-ray treatment in February, 1902, at which time her general health had begun to suffer considerably. She had lost about twenty pounds in weight, her complexion was sallow, and there was an inoperable mass in the iliac region. She has now had the X-ray regularly, from two to four times a week, for more than a year.

At the present time the glands are slightly smaller than they were a year ago, and her general condition has distinctly improved. Her weight has increased fifteen pounds.

This is the only case of melanotic sarcoma in which I had an opportunity of testing the X-ray treatment.

The cases of spindle-celled sarcoma are, likewise, of special interest. I have used the X-rays in only six cases of spindle-celled sarcoma and in two of these as a prophylactic.

The first case, a sarcoma of the superior maxilla, recurrent, which had nearly disappeared under the mixed toxins, but had again begun to increase, was given the X-rays in February, 1902. The treatment was kept up for three weeks without any effect in either checking the growth of the tumor or alleviating the pain, which was severe.

The second case was a spindle-celled sarcoma of the cutis, starting just above the angle of the jaw on the left side of the face. The patient was a man, aged forty-one years, with the history of having injured the palm of his left hand with a pointed stick, about two years before. A small hard spot appeared at this site several months afterward, and was removed by a physician without examination. In the spring and early summer, 1902, he had very severe hemorrhages from a supposed gastric ulcer. These were finally controlled, and he nearly regained his normal weight. In the early fall of 1902 a thickening or infiltration about the size of a lima bean appeared in the skin over the left scapula. Almost at the same time a similar growth appeared in the skin over the angle of the jaw, as described. I first saw the case in consultation in the early part of October, and was in the beginning inclined to believe it non-malignant, but advised excision of the small tumor in the back for examination. This was pronounced spindle-celled sarcoma by the pathologist, in Brooklyn. The patient came under my care two weeks later at the General Memorial Hospital, and small doses of the toxins were administered subcutaneously in the back, and the X-ray was given four times a week over the small tumor of the face. Very little change was noticed in the face, but there was no recurrence evident in the back. At the end of four weeks small doses of the toxins were given directly into the tumor of the face, although the tissue there was so very hard that it was difficult to introduce the needle, and the injections were very painful. At this time I excised a piece of the tissue from the face and had it examined by Dr. George P. Biggs, pathologist of the New York Hospital,

who pronounced it a fibrosarcoma, the fibrous tissue greatly predominating over the cellular, and he believed it to be of an extremely low type of malignancy. The growths slowly decreased in size under the combined treatment, and in the early part of December the patient returned to his home. The toxins were discontinued while the X-ray treatment was kept up at the office. The growth in the face increased rapidly, extending by infiltrating the adjacent skin in every direction, producing a gradually widening area involving all the layers of the skin not attached to the deeper parts.

The combined treatment of the toxins and X-rays was resumed on December 20th, and again the tumor began to slowly decrease in size. By this time it had extended downward entirely around the chin and was beginning to ascend on the other side, and had involved the skin of the neck down to a level with the upper border of the thyroid. The glands were in no way affected; the skin could be moved freely over the deeper parts. The X-ray was pushed to the point of producing a burn. About January 1st he began to show evidence of generalization of sarcoma. Small nodules similar to that in the face and back began to appear in the scalp. The patient began to complain of very severe pains in the lower spine, which it required large doses of opium to control. He lost flesh very rapidly, and by the middle of February showed signs of jaundice, becoming greatly emaciated and weakened. The X-ray treatment was abandoned and the toxins were given in very large doses by his family physician, Dr. Herbert F. Williams, of Brooklyn, as much as twenty minims of the Parke, Davis & Co. solution being administered. These large doses had a very material effect in reducing the size of the external tumors, but the pain in his spine continued, and his general condition gradually failed, causing death on March 12, 1903.

In addition to the interest attached to this case in connection with the X-ray, it is noteworthy as an example of sarcoma of the cutis —a very rare variety—and also as showing the inability of the pathologist to give an accurate prognosis from a microscopic examination of the tissue. From the pathologist's standpoint we had to deal with an almost pure fibroma of extremely low malig-

nancy. And yet the clinical course was one of the most rapid that I have ever observed in any variety. The entire duration of life, from the first appearance of the tumor upon the face, in October, 1902, to March 12, 1903, was less than six months. In two cases of spindle-celled sarcoma this treatment was given as a prophylactic.

Two of the most important cases bearing upon the value of the X-ray in sarcoma are the following, in which the patients were formerly under my care, but were later treated by the X-ray by other men:

Case I.—Male, aged seventy years, with small round-celled sarcoma of the neck, six times recurrent, and apparently absolutely hopeless. The X-ray treatment was begun by Dr. E. R. Fiske, of Brooklyn, on December 22, 1901. A static machine was used daily, and exposures of ten minutes' duration were given the first few weeks; these were gradually lengthened to twenty minutes, and the treatment was continued, with occasional intervals of rest, for a year. At the X-ray meeting of the Academy of Medicine, March 9, 1902, I showed the patient in perfect health, and there was not the slightest suspicion of tumor or induration in the neck. The growth that had been noticed in the right axilla had also disappeared. A communication from Dr. Fiske, dated January 23, 1903, states that the patient is free from recurrence, in fine health, and has gained in weight.

Case II.—Female, aged thirty-four years, with spindle-celled sarcoma of the abdominal wall, extending from the symphysis pubis nearly to the ensiform cartilage; the tumor was about the size of an eight months' pregnant uterus. The patient was in very bad health in January, 1902; the tumor was growing very rapidly, and considered beyond all hope. A trial with the X-ray was advised, and the patient went to New Haven, Conn., where she has been under the care of Dr. Clarence Skinner, a static machine being used. By September there had been some diminution in size and marked improvement in general health, so much so that she was able to resume her former work as school-teacher. Since

Round-celled sarcoma of orbit and neck. Before treatment with X-rays and mixed toxines of erysipelas and *Bacillus prodigiosus*.

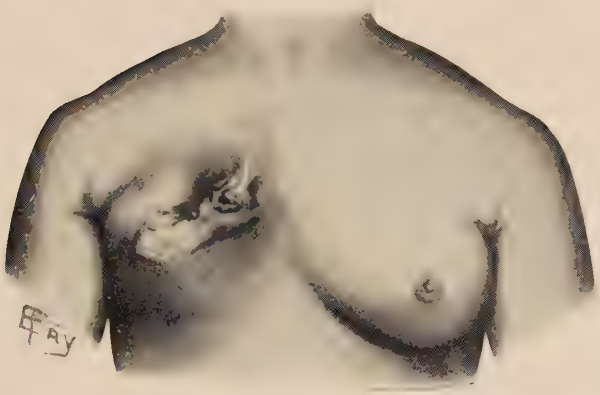
The subject of Fig. 1, after two weeks' treatment.

(NOTE.—August 31, 1901, patient in hopeless condition from recurrence in orbit.)

FIG. 3.

Cancer of the breast. Before treatment with the X-ray.

FIG. 4.



The same as Fig. 3, but after three months' treatment with the X-ray.

FIG. 5.

The same as Fig. 3, but after six months' treatment.

that time she has had from two to three treatments, from Friday until Monday, every two weeks.

On March 1, 1903, I made an examination of the patient and found that all remaining of the large tumor was a mass, about the size and thickness of my hand, situated between the symphysis pubis and the umbilicus.

This patient was originally sent to me by Dr. Richardson in April, 1901, for toxin treatment, and while there was considerable improvement at first, later the treatment had apparently no effect, and growth became very rapid. This is the only case of spindle-celled sarcoma that has come under my observation in which the X-ray caused marked improvement. The patient, who is a very intelligent woman, describes very accurately the phenomena connected with the disappearance of the growth, and I think her statements are worthy of record: The original tumor was of board-like hardness, and she states that during the treatment certain areas became moderately painful. A little later these painful areas became softer, and gradually the soft areas seemed to become absorbed, leaving areas of depressions. This process continued in different parts of the tumor, slowly causing disappearance of the greater portion of it.

A comparison of the results of the X-ray treatment in sarcoma and deep-seated carcinoma seems to prove that the influence of the X-ray in the majority of cases is much more powerful upon sarcoma than carcinoma. I have had under treatment thus far twenty-five cases of carcinoma of the breast, all recurrent, inoperable cases, and in only one instance has a large tumor entirely disappeared, though in sarcoma multiple small nodules have disappeared. This case, as may be seen from the drawing taken from a photograph, shows an extensive, ulcerated carcinoma, which has destroyed the entire right breast, and which, under about six months' treatment with the X-ray, completely disappeared. The patient's general health remains good. I do not believe, however, that the patient is cured; and if treatment were discontinued there would probably be a speedy return of the disease.

This case is almost identically the same as that described by Mikulicz in the *Beitrage z. klin. Chir.*, Band xxxvii., S. 676. It shows that, occasionally, deep-seated carcinoma of the breast may disappear under the influence of the Roentgen ray.

The Relative Merits of the Toxins and X-rays in Inoperable Sarcoma.

The time has been too short and experience too limited thus far to definitely decide this question. It is fair to say, however, that in several cases of inoperable round-celled sarcoma in which the toxins had been tried and failed the X-ray caused entire disappearance of the tumors. Yet, there has been a speedy recurrence in every one of the cases.

On the other hand, in a much larger number of cases of inoperable sarcoma, the tumors have entirely disappeared under the toxins, and remained well from three to ten years after treatment. (I have had twenty patients with inoperable sarcoma remain well from three to ten years after the disappearance of the tumor under the mixed toxin treatment. Of these, fifteen patients were well from five to ten years.)

As stated above, I had the opportunity of observing the effect of the X-ray upon only six cases of spindle-celled sarcoma, and found it to be exceedingly slight in most of these cases. Yet, it is just in this class of cases—the spindle-celled—that the result of the toxin treatment has been by far the most satisfactory, nearly 50 per cent. of the cases of inoperable spindle-celled sarcoma having disappeared under the treatment in my own experience. In the round-celled variety, however, upon which the influence of the toxins is much less pronounced, the immediate results from the X-ray treatment seem to have been the best. In one of my cases, a very large inoperable round-celled sarcoma, two-thirds of the growth had disappeared under the toxin treatment, and at this point the X-ray was used in addition to the toxins, with the result that the entire tumor disappeared three months later.

In deep-seated and inaccessible growths the results from the toxins will probably prove better than from the X-rays.

TABLE OF SARCOMA CASES TREATED BY THE X-RAY, FEBRUARY, 1902, TO MAY, 1903.

No. of case.	Sex and age.	Locality.	Type of sarcoma.	Duration of treatment.	Results.
1	F. 42	Neck, pectoral region, axillæ, groin and abdomen.	Round-celled, recurrent.	Treatment began Oct., 1902; still under treatment May 11, 1903.	Entire disappearance of tumors in neck, pectoral region, and axillæ; recurred in four months in groin and abdomen; disappeared in groin; decreasing in abdomen.
2	M. 8	Back.	Round-celled, recurrent.	4 mos.; began March, 1902.	Disappeared; recurred in two months; removed, and X-ray given as prophylactic. Still well May, 1903
3	M. 19	Femur.	Round-celled.	X-ray begun Feb. 1902; continued May 11, 1903; toxins last 3 mos.	Tumor in femur apparently cured; metastases in pectoral, lumbar, and iliac regions.
4	M. 42	Femur (stump).	Round-celled.	X-ray and toxins 3 wks.	Decrease in size of tumor two inches; general health very bad; sent home.
5	F. 34	Back.	Round and spindle-celled.	X-ray and toxins 2–3 mos.; treatment began Nov. 1902.	Relapse April, 1903; under treatment at present; improving.
6	F. 25	Thigh.	Round-celled.	X-ray and toxins for 1 mo.	The disease was apparently not in the slightest way influenced by the treatment.
7	M. 38	Pectoral region.	Round-celled.	X-ray and toxins 4 mos., from Feb. to June, 1902.	Entire disappearance; slight recurrence six months later; treatment resumed, and continued for six weeks with the result that there is now no trace of the disease left.
8	F. 35	Iliac glands.	Melanotic, recurrent.	X-ray 1 year.	At first growth was merely held in check; of late there is some improvement.
9	M. 65	Thigh.	Round-celled?	X-ray 4 mos. by other physician; resumed by me for two weeks; stopped.	Great decrease in size; one month after cessation of treatment began to increase again; the effect of renewed treatment remarkable, but with rapid disappearance of tumor-masses general health failed and continued to fail after cessation of treatment. Died Jan. 5, 1903.
10	M. 26	Thigh.	Round-celled.	X-ray and toxins 3–4 mos., Oct. 1901, to Sept. 1902.	Apparent retardation of growth for a time; later metastases in lung. Death January, 1903.
11	M. 46	Superior maxilla.	Spindle-celled.	X-ray and toxins 3 wks.	Without effect upon either pain or growth.
12	M. 42	Orbit.	Round-celled, recurrent.	Toxins and X-ray 4 mos.	Growth apparently held in check at first, but later seemed to have no effect.
13	M. 38	Neck.	Round-celled (?)	X-ray 2 mos.	No improvement.
14	F. 60	Ribs and kidney.	Spindle-celled.	Toxins and X-ray two mos.	Marked improvement; still under treatment.
15	F. 45	Parotid, recurrent	Round-celled.	X-ray and toxins 5 mos.	No improvement.
16	M. 55	Testis.	Round-celled, recurrent.	X-ray and toxins 2 mos.	Improvement; was obliged to leave hospital for disobeying rules.
17	F. 15	Neck,	Round-celled.	X-ray 4 mos. as prophylactic	No return of the disease thus far.
18	F. 60	Frontal sinus.	Round-celled.	X-ray and toxins 6 mos.	Tumor decreased in size; very marked improvement in general health; still under treatment.
19	M. 37	Neck.	Round-celled, recurrent.	X-ray 4 weeks.	No improvement.
20	M. 45	Neck and rib.	?	X-ray and toxins 2 mos.	Slight improvement.
21	F. 35	Parotid.	?	X-ray 2 mos.	No improvement.

No. of case.	Sex and age.	Locality.	Type of sarcoma.	Duration of treatment.	Results.
22	M. 44	Chest wall.	Spindle-celled.	X-ray, only six treatments; prophylactic.	Still well.
23	M. 25	Parotid.	Round-celled, recurrent.	X-ray and toxins 3 wks.	No effect. Death five months from first appearance of tumor.
24	M. 26	Ribs and hand.	Round-celled, recurrent.	X-ray and toxins 2 mos.	Very marked decrease in size of both tumors; still improving.
25	M. 38	Buttock.	Round-celled.	X-ray and toxins 2 mos.	Improving.
26	F. 40	Sacrum and pelvis.	Osteosarcoma round-celled.	X-ray 3 mos.	No improvement.
27	M. 32	Orbit and neck.	Round-celled (?)	X-ray 3 wks.	Very marked improvement; still under treatment; tumor on one side of neck entirely gone.
28	M. 55	Superior maxilla.	Round-celled.	X-ray 6 wks.	No improvement.
29	F. 56	Pectoral region.	Spindle-celled.	X-ray 6 wks.; prophylactic.	Still well May 11, 1903.
30	F. 34	Ovary and abdomen.	Spindle-celled.	Patient so weak only 3–4 treatments given	No improvement.
31	M. 24	Upper jaw.	Round-celled.	X-ray and toxins 4 mos.	Improvement at first; later no effect.
32	M. 41	Skin, back, and face.	Spindle-celled, multiple.	X-ray and toxins 4 mos.	Improvement at first; later no effect. Died March, 1903.
33	M. 32	Buttock and ischium.	Round-celled.	X-ray 2 mos.	No improvement.
34	M. 45	Skin.	Mixed-celled, multiple, recurrent.	Toxins and X-ray for 6 mos.	Slight improvement at first.
35	M. 42	Intestine.	Round-celled.	X-ray 6 wks.	No improvement.
36	M. 42	Testis.	Round-celled.	X-ray and toxins 3 mos.	No improvement.

There is no objection to using both methods of treatment at the same time, and there is reason to believe that the combined treatment will give better results than either used alone. There are a large number of cases of inoperable sarcoma treated either with the X-ray or the toxins, in which the inhibitory action is almost, but not quite, sufficient to check the growth; and it seems but reasonable to suppose that the combined action of the X-rays and toxins might be sufficient not only to check the growth, but to cause it to disappear.

Dangers. Besides the danger of burns resulting, either from careless application of the rays or unusual susceptibility on the part of the patient to their influence, there is the danger of toxæmia. From too vigorous an application of the rays in large and very

vascular tumors, the rapid breaking down or tissue necrosis is followed by the absorption of so many toxins or products of degeneration that the patient is liable to quickly develop the symptoms of toxæmia, which may easily prove fatal, as has been the case in several instances that have come to my knowledge. There is also the possible danger that in the rapid breaking down some of the living tumor cells may be carried to remote parts of the body, causing metastases.

Conclusions. From personal experience as well as from a study of the cases of sarcoma treated with the X-ray that have thus far been reported I do not believe we are justified in using the method in any save inoperable cases. An exception to this general rule might be permissible, perhaps, in the cases of sarcoma of the extremities, in which operation would necessitate amputation. I believe that in such cases a brief course of the combined X-ray and toxin treatment would be perfectly justifiable and might result in the saving of the limb.

In support of this view I would cite a case of recurrent spindle-celled sarcoma of the tibia in which the diagnosis had been confirmed by careful microscopic examination, made by Dr. John Caven, Professor of Pathology of the University of Toronto. Six years ago I administered the toxins for several weeks at the General Memorial Hospital, with the result that the growth entirely disappeared, and the patient has continued his occupation as a farmer ever since. I heard from him a few weeks ago, and he is still in perfect health. The only operation to be considered in this case would have been amputation above the knee.

Thus far we have proved that the X-rays have a very decided inhibitory action upon the various forms of sarcoma, in certain cases sufficient to cause the entire disappearance of inoperable tumors. Yet there is a strong tendency to local or general recurrence, and in no instance has sufficient time elapsed to warrant us in considering the patient cured.

Good results cannot reasonably be anticipated without prolonged treatment extending over many months, and in some cases years.

THE PRESENT STATUS OF THE TREATMENT OF SUPERFICIAL CARCINOMATA AND TUBERCULOSIS BY MEANS OF THE X-RAY.

By WILLIAM L. RODMAN, M.D., and G. E. PFAHLER, M.D.,
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In studying this subject we have not confined ourselves to our own experience, but have reviewed rather extensively, though hastily and incompletely, the literature upon the subject and have drawn our conclusions from both these sources.

Many of the reports upon this subject have been necessarily incomplete. In many instances the treatment was interrupted before conclusions could be drawn, in others important details were omitted, and in others the patients were still under treatment, with the hope of finally being cured. Part of the work has been done by experienced men—men who have had a general experience with the X-ray even before it was used for therapeutical purposes—while part was done by beginners. On account of these varying conditions it is difficult to draw conclusions, but inasmuch as the future work will be done under the same circumstances, it is fair to use all the reports made by regular physicians in estimating the true value of the treatment. We realize that by the end of a year our conclusions are likely to be changed.

We find reports of the treatment of 234 cases of epitheliomata and mere reference to a much greater number. Of these, 147, or 63 per cent., have been cured; 87, or 36 per cent., have been reported improved, and 2, or 1 per cent., unimproved. The least number of treatments needed in any case reported cured and in which this detail was given was 4, the greatest 68, the average 25. The least time required was three weeks, the greatest twenty-two weeks, the average was eight weeks. In many reports the number of treatments

and the time required to effect a cure were not given. In such instances the time and the number of treatments required were probably considerably greater than the average given, and therefore we believe that the average time required to effect a cure is greater than eight weeks, probably not less than twelve to sixteen weeks. There are probably many cases that have been cured and many more that have not been cured that have not been reported.

When we realize, however, that the greater number of these cases were recurrent or inoperable, either because of their extent or their location, and in many instances the cures and improvements were remarkable, we must acknowledge that the X-ray is a valuable adjunct to surgical treatment.

The time and number of treatments, of course, will always vary with the extent of the growth, the susceptibility of the individual, and the skill of the operator, but we feel that the surgeon should have some general idea of the time required to effect a cure.

In a number of cases reported, for instance, by Beck the growth made its appearance later in the adjoining glands. These glands should always be treated. In some instances in which the glands later showed the disease, as in a case reported by Pfahler, they were not only not treated but were protected from the ray.

Recurrences in the growth itself have been reported, but these were easily controlled by a reapplication of the rays. On the other hand, cases can be shown by ourselves and many others that have remained well two years or more.

At least 90 cases of rodent ulcer have been reported as being treated by the X-ray. Of these, 43, or about 48 per cent., have been cured, and 47, or 52 per cent., were still under treatment and improving at the time of the reports. The time and number of treatments have been given in too few instances to justify any conclusions. It requires, however, from one month in a small lesion to many months when the ulcer is large or where bone and cartilage have been exposed.

Sequeira, who has done more work upon rodent ulcer than anyone else, has had a number of recurrences, but in each instance the ulcer was again healed by a reapplication of the rays.

At least 74 cases of lupus vulgaris have been reported. Of these 65, or 88 per cent., have been cured, and 9, or 12 per cent., were improving at the time of the reports. The number of treatments were given in only 10 cases, the least being 8 and the greatest 87, the average 31. The least time required was four weeks, the greatest twelve weeks, and the average was eight weeks. We believe that the average number of treatments required will not be less than 40 and the time not less than twelve weeks.

We find records of 8 cases of lupus erythematosus with 8 cures, or 100 per cent. This is surely too high. Judging from our experience and from information obtained by conversation with other workers, lupus erythematosus is as difficult to cure by means of the X-ray as lupus vulgaris.

In a number of cases the disease has recurred, but in each instance it was controlled by repeating the applications. Jutassy states that nearly fifty cases of lupus treated by means of the X-rays by Kümmell, Freund, etc., have been published, and that of the older cases about 50 per cent. have had a recurrence, but that there are cases reported by Gocht, Kümmell, and Albers-Schönberg which were treated two years ago and have had no recurrence. The final results, therefore, seem to compare favorably with any other method of treatment.

Following the application of the rays to lupus there is a reaction in the tissues, shown by an erythema in the diseased and in the healthy tissue, and, as described by Kümmell, cleansing of the ulcers, cicatrization, drying up and falling off of the scabs, peeling of the skin, decrease in the size of the nodules, disappearance of the redness, and the formation of a white scar without contraction.

At least 8 cases of tuberculous glands have been reported; 2 were cured, 5 were improving, and 1 was unimproved. To this small number we can add 2 cases in both of which two operations had been performed, followed by a recurrence which is now disappearing under the influence of the rays.

We have found records of 4 cases of Hodgkin's disease. The 4 were improving at the time of the reports and the authors were

hopeful of a complete cure. In the treatment of this disease we have had no experience.

Three cases of tuberculous ulcers have been reported cured, requiring about 16 treatments and fourteen weeks' time. In several other instances reference was made to the curability of these ulcers without giving any report of cases. We have one undoubted case in a young girl, in which the ulcers varied from one-half to two inches in diameter. Even the largest of these is nearly well.

The term "cured" as applied to the above cases cannot be accepted in its true, literal sense, but must be taken to mean a disappearance of the tumor, the ulcer, the tubercles, or enlarged glands.

While nearly all investigators must and do agree that it is not absolutely essential to develop a reaction in the tissues, as is evidenced by an erythema or dermatitis, yet most of us agree that the more rapid and positive results follow such reaction. In a certain number of cases no effect was noticeable, even after a long course of treatment, until such reaction had occurred. Varney has found it necessary to burn into the true skin before the carcinoma or sarcoma was influenced. Grubbé says that he has burned every patient treated and some of them have been burned repeatedly.

A number of theories of the physiological action of the X-ray have been advanced, but as yet they remain theories. The actual pathological changes, however, have been studied more or less carefully by Pusey, Ellis, Scholtz, Walker, Blackmar, Beck, Leob, Herzog, Freund, Sequeira, Mayou, and others. They find necrosis of cells and trabeculæ, at times fatty degeneration, increase in the elastic tissue, and a tendency to occlusion of the bloodvessels by a deposit on their inner surfaces. This last phenomenon is interesting in that it will probably explain the lessened tendency to bleeding after exposure to the X-ray.

Sequeira found, by microscopic study of rodent ulcer, two important results. In the first place, the epithelial cells were destroyed, the nucleus and protoplasm undergoing lysis. In some cells a definite fatty change was seen. The second change noted

was stimulation of the connective tissue elements leading to filling up of cavities and to formation of healthy scar tissue.

There is certainly an idiosyncrasy in individuals which must be carefully studied. In one of our patients, during an examination of the head, the hair on one side was removed by an exposure of two and a half minutes, while other patients have had repeated and long exposures without loss of hair or dermatitis. Grubbé has treated one case daily for two years with the tube very near the body and only produced a slight redness. On the other hand, in some cases a single exposure has produced a well-marked dermatitis.

The mucous membrane of the lip seems to be especially sensitive to the X-ray, and therefore should always be carefully protected when not involved by the diseased tissue. The conjunctiva and tissues about the eyes are not especially affected by the rays, as shown by cases treated by ourselves and others in which the diseased tissue occupied the lids.

The advantages of the treatment, given by Pusey, are as follows: (1) It is painless. (2) It destroys diseased tissue, but leaves healthy tissue in its place. (3) It leaves a minimum scar. (4) It can be used when the surrounding tissue cannot be sacrificed. (5) It relieves pain and induces sleep.

Our conclusions are as follows: 1. The length of time required for the cure of epitheliomata is longer than by surgical or caustic treatment, while the cosmetic results are better. The dangers are proportionate to the urgency of the treatment, as indicated by the degree of malignancy. It should only be recommended in cases that are inoperable, either because of the extent of the growth or its location.

2. It is probably the best means at our command for the treatment of superficial tuberculosis and gives better cosmetic results.

3. It should follow all operations for malignant disease or tuberculosis, with the twofold object of stimulating the healing process and of preventing a recurrence. In some cases it may be of an advantage to give a short course of treatment before operation, to destroy the outlying portions of the growth and make such operation of a less formidable nature.

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SOME EXPERIENCES IN THE TREATMENT OF INOPERABLE MALIGNANT GROWTHS BY THE X-RAYS.

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APPARATUS AND TECHNIQUE.

Source of current, 110 volts direct commercial circuit. Fifteen-inch spark length Willyoung induction coil.

Interrupter. Wehnelt electrolytic interrupter and Heintze electrolytic interrupter.

Tubes. Dr. E. Grünmach's water-cooled X-ray tube; size, forty centimetres spark length.

The resistance of the tube was varied between three and ten inches of spark length in air, regulated according to the conditions in the individual case, as hereinafter described.

The distance of the target from the skin was variable. Beginning at a distance of twelve inches, it was gradually diminished to six inches in case tolerance on the part of the individual became evident after numerous exposures.

Protection for the surrounding parts consisted of sheets of lead-foil weighing ten ounces per square foot. It was insulated from the body of the patient by some non-conducting material, such as folded towels. It was not found necessary to ground this lead screen, except in a few instances when treating specially sensitive areas on the face. In these cases it occasionally happened that stinging and pricking sensations were felt in places where the lead closely approached the skin.

Grounding of the shield prevented this. The duration of the exposure was ten minutes for each diseased area. The frequency

of the exposures was six times a week when circumstances permitted, until some evidence of dermatitis appeared. The treatment was then stopped until the acute dermatitis had passed, when it was resumed cautiously and continued according to the susceptibility of the individual case.

In a considerable number of cases of apparently operable and inoperable malignant disease the patients did not continue under observation long enough to enable me to draw a definite conclusion as to the result of the X-ray treatment. These cases are omitted from this report.

The cases of inoperable malignant disease in which a definite conclusion as to the results of treatment can be drawn number ten. Of these, eight are known to be dead; two remain alive. Nine were cases of carcinoma, one tumor was a sarcoma.

Case I. T. G., a man, aged fifty years, was a case of epithelioma of the inguinal, femoral, and iliac lymphatic glands following amputation of the thigh for epithelioma of the leg occurring in the scar of a burn. The disease recurred in the glands of the groin. An extensive operation was done and the disease speedily returned.

No beneficial effect was observed as the result of the X-ray treatment in this case. The disease advanced rapidly until the patient's death.

Case II. Male, aged fifty-seven years, had epithelioma of the lower lip, the lower jaw, and the submaxillary and submental lymphatic glands. This case remained under treatment for seven months. The number of exposures was one hundred, both high and low resistance tubes being used in this case. The superficial portions of the growth showed continual improvement throughout the treatment. The deeper portions of the growth were not greatly influenced and continued to involve the neighboring structures, although more slowly perhaps than would have been the case had the X-rays not been used. The patient died in less than one year from the time when the recurrence was first noted.

Case III. Male, aged seventy years, had carcinoma of the parotid gland and cervical region. The tumor was of large size,

but was not ulcerated. The tumor was not apparently affected by the treatment and continued to advance until the patient's death. In this case the number of exposures was thirteen during a period of one month. It is probable that the growth was accelerated rather than retarded in its progress by the X-rays.

Case IV. Mrs. W., aged fifty-two years, had recurrent carcinoma following an operation for carcinoma of the breast. The patient had been operated upon by a thorough operation about one year before for carcinoma of the breast. The disease had recurred six months later along the line of the cicatrix. A second operation had been done and several small nodules had been removed. This operation had been followed by a second recurrence in and upon the sternum. The tumor was as large as the half of a mandarin orange. The skin was not ulcerated.

The patient was exposed to the X-rays twenty-five times during a period of thirty days. At the end of two weeks from the first exposures the tumor began to diminish in size and at the end of thirty days it had so far diminished as scarcely to be elevated above the level of the surrounding skin. At this time there was an area of sharp dermatitis over the area exposed to the rays. The patient's general health began rapidly to deteriorate. She suffered from profound malnutrition and diarrhœa. A large hard tumor rapidly developed in the region of the gall-bladder. She became jaundiced and died of malnutrition in about four months after the commencement of the X-ray treatment.

Case V. Mrs. N., aged forty-one years. About one year before she came under my observation she had been operated upon for carcinoma of the breast. The tumor had existed for nearly one year before the operation was done. A recurrence took place along the line of the scar about three months after the operation. The recurrence consisted of a number of small nodules in the skin along the line of the cicatrix. The patient's health was fairly good. She was exposed to the X-rays forty-seven times during a period of ninety days. After ten exposures the nodules in the skin were notably diminished in size. In this case the face alone was protected by means of a leaden mask. The entire thorax and neck

were exposed to the influence of the rays; both high and low tubes were used, the tube being placed in several different positions during each treatment, so that the entire thorax and neck were irradiated.

In spite of this, other nodules appeared in the opposite breast, in the axilla, at the root of the neck, and along the course of the great vessels on both sides of the neck, and, in spite of the most vigorous treatment, at the end of three months it was evident that no benefit was being derived from the exposures. The patient's health and strength had, during this period, slowly but steadily deteriorated. After the cessation of the treatment a rapidly growing tumor appeared in the parotid gland on one side. This tumor ulcerated and finally caused death by pressure on the trachea and larynx about five months after treatment was commenced.

Case VI. Mrs. McG., aged sixty-six years, came under my observation October 1, 1902. There was a tumor as large as a hen's egg in the right parotid gland. The tumor had appeared only a few weeks before and had grown rapidly. The physical condition of the patient otherwise was good. Owing to her age and the apparently deep connections of the growth, an operation was not considered desirable. The tumor was exposed to the X-rays eighteen times during the month, and, on account of the occurrence of slight dermatitis, the treatment was intermitted for ten days. The treatment was then recommenced and twenty-two exposures were made. During the time the patient was under observation no beneficial effect could be observed upon the growth of the tumor, which steadily increased in size until the patient's death from exhaustion, February 3, 1903.

Case VII. Miss T., aged sixty-three years, came under my observation December 22, 1902. She had been operated upon for carcinoma of the breast about one year before. The tumor had existed about one year before any operation was done. When seen on December 22d her general condition was not good. She was very anæmic and suffered from disturbances of digestion and headaches. There were a number of small nodules of carcinoma in the skin along the scar of the operation wound, and other nodules could

be felt deeply seated in the intercostal spaces. There were no physical signs observed of intrathoracic disease, nor could any tumor be felt in the abdomen. The entire thorax was exposed to the X-rays thirty-three times between December 22, 1902, and January 31, 1903. During this time the nodules in the skin disappeared and the nodules in the intercostal spaces diminished in size. The general condition of the patient, however, grew steadily worse. She became weaker and more emaciated; the condition of her digestive apparatus grew worse; hemorrhages occurred into the subcutaneous tissues here and there throughout the body; her mental condition became dull and apathetic, and she died unconscious on March 1, 1903.

Case VIII. Mrs. F., aged forty-seven years. She had been operated upon for carcinoma of the breast eighteen months before. The disease had returned in the cervical and mediastinal glands twelve months after the operation. At the time she came under my observation the patient's general condition was quite good. She was not notably emaciated nor anæmic. Her chief complaint was of dyspnœa on exertion. The root of the neck on either side of the middle line was occupied by easily palpable carcinomatous masses. There were enlarged cervical lymph nodes on both sides along the course of the vessels. Auscultation over the lower part of the trachea enabled one to hear a loud whistling sound, as though the calibre of the trachea was diminished. In spite of the most vigorous treatment with the X-rays the tumors steadily increased in size and the patient died about six weeks from the time the treatment was inaugurated.

The following two cases remain alive:

Case I. E. B., a female, aged sixty-five years, twenty-five years ago had a tumor develop in her left breast. The breast and the tumor were removed. The character of this tumor is unknown. Fifteen years later a second tumor appeared in or near the site of the former operation. This tumor was removed. Pathological diagnosis of this tumor was carcinoma. Four years ago a local recurrence took place in the scar of the former operation. The

growth had slowly increased in size up to the present time. The patient came under my observation on December 16, 1901. Her general health at this time appeared to be fairly good. The following lesions were noted:

There was a tumor occupying the left side of the thorax in front. The tumor was flat, firmly adherent to the ribs, exceedingly hard, sharply circumscribed from the surrounding skin. It overlay the region formerly occupied by the breast and measured three and a half inches horizontally, three inches vertically, and appeared to be three-quarters of an inch thick. There was a circular ulcer about two inches in diameter on its surface. The discharge from this raw surface was serous and small in quantity. Surrounding this central growth were numerous firm nodules varying in size from that of a pea to three-quarters of an inch in diameter.

They were situated in the skin and subcutaneous tissues of the thorax and in the opposite breast. There were several large lymph nodes to be felt in the left axilla. Similar nodules to the number of one hundred or more existed in the anterior abdominal wall.

The patient was exposed to the X-rays four times a week. In the course of a month the ulcerated area had healed. The large tumor had also diminished in size and the smaller nodules had commenced to undergo atrophy and absorption without ulceration.

After six months of this treatment, namely, in May, the main tumor had entirely lost its former character and was converted into a thin white layer of scar tissue overlying the ribs. Nearly all the secondary nodules had disappeared. A dozen new nodules, however, had developed on the back in the scapular region, and upon the right side of the abdominal wall in front in an area which had not been exposed to the X-rays numerous new nodules had developed. These new nodules improved and gradually disappeared under treatment.

An interval of two months occurred during June and July, during which the patient received no treatment, and about August 1, 1902, a new crop of lenticular nodules had developed in the skin on the front and upper part of the thorax on either side of the middle line, as well as numerous nodules in the left iliac region.

During August, September, October, and November the patient was treated over all the diseased areas vigorously four or five times a week. The length of the exposures was increased from ten to fifteen minutes. January 1, 1903, nearly all the lesions had disappeared or were greatly improved. At this time a pretty severe dermatitis developed and the treatment was discontinued and up to the present writing has not been resumed. The patient's general health during this time has remained fairly good and has improved rather than otherwise. There are no signs of internal carcinoma.

These results coincide with the experience of others, indicating that the X-rays cause the disappearance of superficial carcinomata and that the efficiency of the rays rapidly diminishes with the depth from the surface of the lesions. Several of the growths appeared to be stimulated by the action of the rays and, in my belief, they grew faster as the result of the X-ray treatment.

It has been suggested that in certain cases a more or less vigorous irradiation might, on the one hand, cause degeneration or, on the other, stimulation of malignant growths, and that further experience might lead to definite knowledge useful in determining the proper method to be employed in the given case. Assuming that such a relation of cause and effect actually exists, it is my belief that at the present time we are not in a position so to regulate the treatment as to produce the desired result in rapidly growing subcutaneous or deep carcinomata. It is quite true that several of the cases spoken of in this paper were so far advanced as to render any hope of benefit beyond reason; yet the entirely negative results obtained are nevertheless interesting. Still, in every case treated the patients were relieved from pain almost immediately to a notable degree. In several of them the mental condition was rendered less desperate and, for a time, hope took the place of despair.

Case II. But one case of sarcoma has been under observation long enough to enable me to form a definite opinion as to the results. The patient was a female, aged thirty-two years. The tumor was a mixed round and spindle-cell sarcoma which had developed several years before in the left parotid region. It had been oper-

ated upon originally by Dr. Charles McBurney, and later local recurrences to the number of six had been operated upon after varying intervals by Dr. Frank Murray and Dr. McBurney.

The patient was first seen by me May 10, 1902. At this time there was a large tumor in the left parotid region involving the body and the horizontal ramus of the lower jaw. The tumor extended upward as far as the upper border of the external ear and downward into the submaxillary region. There was a secondary small tumor in the temporal region and a third in the neck over the middle of the sternomastoid muscle. The skin was not involved. The tumor was hard, but had no very distinctly marked borders. The condition was clearly an inoperable one.

The patient was exposed to the X-rays nearly every day until July 25th. At this time the tumor had so far diminished in size that only a moderate thickening remained over the body of the lower jaw. A moderate dermatitis having developed, treatment was discontinued until September 7, 1902. At this time there was no sign of a renewed growth. The thickening of the jaw was less marked. Treatment was then resumed daily until October 13, 1902. At this time another attack of dermatitis occurred and treatment was discontinued. The thickening of the jaw was scarcely noticeable. Treatment was resumed November 6, 1902, and continued daily until November 25, 1902. The tumor was apparently cured. In order to avoid the danger of recurrence daily treatment was recommenced January 6, 1903, and continued until February 1, 1903. A dermatitis having developed, the treatment was discontinued. I should regard it as wise to continue the X-ray exposures at intervals for six months longer.

DISCUSSION ON X-RAY SURGERY.

Dr. Francis H. Williams, of Boston.

I thank you for calling upon me, but I did not come prepared to say anything. I merely desired to listen. But one or two important points have been brought out on which I should like to say a word. In my opinion, cases of new-growths in which the glands are involved are not favorable ones for treatment by the X-rays. As a rule, the glands should first be removed by surgical means, and then the X-rays should be applied. Small growths, either primary, or recurrent after operation, generally yield very well to the X-rays, as we all know, but not always.

Recurrences after the use of the X-rays have taken place, but, on the other hand, persons have remained free from them for a considerable period of time; for instance, some of my cases have remained well for more than three years.

It is interesting to make a comparison between the results obtained after operation and after the use of the X-rays in the same patient. I will mention one such case, typifying a group of cases, that was operated upon for a growth on the arm. A recurrence took place in three months, and a second operation was done; and again recurrence took place, this time in less than three months. The X-rays were then used, and the patient has remained well for sixteen months.

It is very important that we should not do the harm with the X-rays that can so easily be done. To avoid any injurious effects we should be able to measure the amount of X-rays used. Some time ago I devised an instrument, which I have called a fluorometer, and which is described in my book, *The Roentgen Rays in Medicine and Surgery*, for measuring the amount of fluorescence excited, and I assume that this measures the amount of X-rays given off.

The length of the exposure and the distance of the tube should be determined in accordance with the readings obtained by means of the fluorometer.

My results in Hodgkin's disease were surprisingly good at first, but in the earliest case that I treated the symptoms recurred, and the patient did not again improve, in spite of further treatment. The other cases that are under my care are improving. Too vigorous use of the X-rays should be avoided in this as well as in some other diseases, for, if it is not, toxæmia may result.

Dr. W. Joseph Hearn, of Philadelphia.

I see the X-ray used daily in the Jefferson Hospital for the treatment of cancer without any satisfactory results. In the treatment of malig-

nant disease it has its limitations. Cancer of the face, known as rodent ulcer, can be satisfactorily and successfully treated by the rays. There is no harm in waiting for the X-ray to cure in this form of cancer, because we do not have secondary lymphatic involvement. In other cancers migrations of cells will take place before the rays will cure, and we should in these cases operate with the knife at the earliest possible moment. I have never seen cancer, except on the face, cured with the X-ray. Keloid tumors are successfully treated by it.

Dr. Bevan. In my opinion there are two dangers from the X-ray, of which the first is the burning of the patient, although I have had only three burns in thirty-five cases; but this should be a warning against its use by men not thoroughly familiar with it. The second danger is using the X-ray where there is no possible excuse for its being used. Where a patient is dying of carcinomatosis its employment is useless except for using it as an experiment. I believe the X-ray is the therapeutic agent of choice in a few well-selected epitheliomas of the face, and a very extended and thorough trial should be given it as a postoperative treatment. One should make every effort to extend the range of the X-ray, as we know it will accomplish certain things, and it is possible, I believe, for us to extend its usefulness.

Dr. Rodman. I entirely agree with Dr. Coley and Dr. Bevan as to the value of the X-ray, especially in certain epitheliomas of the face, as it will cause the disappearance of these growths with the least possible deformity. I have seen good results follow in such cases, and have also seen improvement in cases of enlargement of the lymphatic glands in tuberculosis. It is a question whether or not good comes from the use of the X-ray in malignant disease where there has been enlargement of the glands. As to the results of the rays when used on deeper tissues, we are still in the dark, but it improves nearly every case more or less. I have seen considerable good follow in carcinoma of the mammary glands, the symptoms of dyspnœa, etc., being improved; but in one case the patient is dying of metastasis. The results are usually temporary, and the time has not come for us to say whether cures will be effected. My experience agrees with Dr. Coley's in cases of small spindle-celled sarcoma. I am using it now on a boy, but I cannot see the slightest improvement. The boy was very badly burned, and I tried for at least three months to help him. In the small spindle-celled sarcoma we can hope for improvement from the toxins rather than from the X-rays, and I have seen a case of cure by the toxins. I had one case which has been operated upon twice, and in this case I used the toxins very persistently for some time; some improvement took place, but I do not know the final results. There was

a most marked improvement in her condition up to the time she left Philadelphia, and the tumor had almost entirely disappeared. If she could have been treated longer she might have been cured. I also agree with Dr. Coley that we should use both the X-ray and the toxin in the treatment of malignant disease.

Dr. Coley. As to the depth of growths which are susceptible to the X-ray treatment, I know of several cases of malignant disease, where the tumors were at great depth, which have been materially improved. In one case the tumor (a round-celled sarcoma) was in the abdominal cavity, and it has nearly disappeared.

As to Dr. Williams' point in reference to not treating those cases in which the glands are enlarged, I think this needs further discussion. I do not think we should treat any case with the X-ray in such an early stage that the glands are not enlarged. We cannot determine without an operation very often whether the glands are enlarged or not, and I think it is bad surgical advice to use the X-ray in the early stage of cancer, presuming that the glands are not enlarged because they cannot be felt.

As to treating Hodgkin's disease with the X-ray, I have had one experience. The treatment was begun last September in a case in which the splenic enlargement was very marked. The cervical, axillary, and inguinal glands were greatly enlarged; yet they have entirely disappeared, and the splenic tumor has been reduced to about one-sixth of its original size.

Dr. Johnson. In my opinion, operable cases of malignant disease had better be operated upon with the exception of superficial epitheliomata situated upon the face or upon regions where the scar is very undesirable, and there the X-rays have a special office and a useful one. I should feel that malignant disease in general where it could be removed by the knife had better be so removed. I do not think we know by any means what the limitations of the X-ray are, but I am speaking from the point of view of our present knowledge. By my own experience I am led to believe that the majority of cases of inoperable carcinoma, while they may be greatly improved and their pains greatly relieved, have finally died of the disease, although perhaps at a later period than if the X-ray had not been used, showing that the disease has not been cured. The suggestion of Dr. Bevan as to whether or not at some future time the activity of the X-rays may not be so modified or increased as to permit us to reach deeper-seated structures is very interesting, and it has occurred to me very many times. I have often striven to arrive at such an end, but heretofore my experience has been like all others, and I have failed. Occasionally, however, from some unknown cause, which may

depend upon the greater susceptibility of some cells than others to the action of the X-ray, we have achieved remarkable results in tumors that were quite deep-seated. I have seen some of these cases myself, but I think it is a misfortune for the general public in general to be allowed to believe that the X-ray is preferable to surgical operations for malignant disease. It is the duty of the medical profession to disabuse the public mind of this idea.

RESULTS OF ONE THOUSAND OPERATIONS FOR THE RADICAL CURE OF INGUINAL AND FEMORAL HERNIA PERFORMED BETWEEN 1891 AND 1902.

By WILLIAM B. COLEY, M.D.,
NEW YORK.

From August, 1891, to March 31, 1903, I have operated upon 1063 cases of inguinal and femoral hernia.

Inasmuch as the purpose of this paper is chiefly to determine the permanent results of operation for the radical cure of hernia, I shall consider only the cases that have been operated upon longer than six months ago. This gives us 1003 cases operated upon during a period of eleven years prior to December, 1902. These cases may be classified as follows:

Inguinal hernia, males		756 cases.
" " females		181 "
		937 "
Femoral hernia		66 "
	Males.	*Females.*
Of these were performed in 1891	8 cases.	2 cases.
" " 1892	20 "	2 "
" " 1893	46 "	3 "
" " 1894	71 "	6 "
" " 1895	51 "	18 "
" " 1896	50 "	20 "
" " 1897	77 "	19 "
" " 1898	71 "	22 "
" " 1899	84 "	21 "
" " 1900	100 "	30 "
" " 1901	79 "	17 "
" " 1902	99 "	21 "
	756 "	181 "
Total number of cases	937	

The ages of the patients were as follows:

Five hundred and thirty-eight operations were performed at the Hospital for Ruptured and Crippled, in children varying in age from four to fourteen years; 465 operations performed else-

where, chiefly at the Post-Graduate and General Memorial Hospitals. The age of these patients ranged as follows:

13 cases	.	.	.	1	to	4 years.	36 cases	.	.	.	40 to 50 years.
38 "	.	.	.	4	"	10 "	19 "	.	.	.	50 " 60 "
99 "	.	.	.	10	"	20 "	6 "	.	.	.	60 " 70 "
177 "	.	.	.	20	"	30 "	2 "	.	.	.	70
77 "	.	.	.	30	"	40 "					

Thus it will be seen that a larger proportion of the cases were children than adults. In 317 cases the patients was over 20 years (20 to 70) and in about 700 under 20 years.

The good results we have had at the Hospital for Ruptured and Crippled have frequently been explained on the theory that the radical cure of hernia in children is a much simpler matter than in adults, and that almost any method of operation will suffice. In answer to this argument I would cite the fact that in twenty operations prior to 1890, in which the Czerny and Socin methods were used, 50 per cent. of relapses occurred within a year of the time of operation. The operation in children is really more difficult than in adults, and needs not only the best methods but the greatest care in technique to give as good results as in the adult. With the best methods and the greatest care in the performance of the operation I believe that the results in children are equal to the results in adults. It will be readily admitted that children and young adults furnish better material for good results than individuals beyond middle life with weak and atrophied muscles. A comparison of my own series of cases with the recent statistics of the Vienna Clinic (800 radical operations after Bassini and end results, Albert's and Hochenegg's Clinic, *Arch. f. klin. Chir.*, B. 68, H. 1) will show a larger proportion of operations in elderly persons in mine.

At the Vienna Clinic it is stated that 804 radical operations were performed upon 473 patients—423 males and 50 females—the age of which was as follows:

1 to 5 years	.	.	.	32 cases.	30 to 40 years	.	.	.	55 cases.
5 " 10 "	.	.	.	22 "	40 " 50 "	.	.	.	37 "
10 " 20 "	.	.	.	112 "	50 " 60 "	.	.	.	16 "
20 " 30 "	.	.	.	199 "					

At the Vienna Clinic	.	.	.	.	.	.	.	53	were over	40	years	of age.
and of my own cases	.	.	.	.	.	.	.	63	"	40	"	"
At the Vienna Clinic	.	.	.	.	.	.	.	112	"	30	"	"
while of my cases	.	.	.	.	.	.	.	138	"	30	"	"

That 804 operations should have been performed upon 473 patients at the Vienna Clinic strikes one as peculiar in the undue proportion of double to single herniæ. The explanation appears later in the text, and rests upon the custom that prevailed at the Vienna Clinic prior to 1898 of always operating upon both sides whenever any enlargement could be made out in the external ring of the opposite side. This, as the records show, resulted in a double operation in nearly every case, whether a hernia was actually present or not. Hence the results of the 804 operations cannot be fairly compared with the results of the operators who have followed the custom of operating only upon actual rather than potential hernia.

My own list of 1003 operations shows only 92 double herniæ or 911 individual patients operated upon.

Allowing a similar proportion of double herniæ to the 473 of the Vienna Clinic, we would have only 520 instead of 804.

FEMORAL HERNIA.

In this group are 66 cases operated upon from 1892 to 1902, with the following results: There was no mortality, and primary union was obtained in all but 1 case. This case furnished the only relapse that has been observed.

The patient, a woman aged thirty-five years, was operated upon in 1896 by Bassini's method for femoral hernia. At the end of one and a half years there was a slight relapse, for which a truss was worn for a short time and then discontinued. Five years later she wore no truss, and there was little more than an exaggerated impulse.

The other cases have remained sound, and all but 8 have been traced as follows:

Well from 10 to 11 years	1 case.	Well from 2 to 3 years	14 cases.
" " 9 " 10 "	2 cases.	" " 1 " 2 "	12 "
" " 7 " 8 "	4 "	6 months to 1 year	3 "
" " 6 " 7 "	1 case.	Less than 6 months	8 "
" " 5 " 6 "	7 cases.	Not traced	8 "
" " 4 " 5 "	3 "	Relapsed	1 case.
" " 3 " 4 "	2 "	Total	66 cases.

Thus it will be seen that 46 were well from one to ten years and 34 from two to ten years after operation.

The methods employed in the femoral cases were the Bassini method for femoral hernia, which was used in 16 cases, and the purse-string suture (with kangaroo tendon) employed in 50 cases. In the latter there has been no relapse.

These cases have been in no way selected, and in every patient during the last five years, no matter how large the hernia, the purse-string suture was used.

STUDY OF RELAPSED CASES.

An analysis of the relapsed cases shows that Bassini's operation was performed in 9 cases, which, in 937 Bassini operations, gives slightly less than 1 per cent. of relapses after this method, and one relapse was observed in a femoral hernia.

There were six relapses in inguinal hernia in which the cord was not transplanted. Looking into the cases individually, we find a special reason for the relapse in most instances. The Bassini relapses were as follows:

Case I.—C. R., aged thirteen years. Very large right inguinal hernia the size of a fist. Operation December 28, 1891. Silk used for buried sutures. This was one of the first cases in which I had employed Bassini's method. The technique was far from perfect, and the dissection difficult and the operation prolonged. The wound suppurated badly, and most of the silk sutures were extruded. Relapse occurred within three months.

Case II.—P. M., aged twenty years. Operation February, 1895. Primary wound healing. Remained well for two and a half years, when he received a severe kick in the groin, over cicatrix of hernia wound, during a fight. A protrusion was noticed almost immediately afterward. The relapse was slight, and did not enter the scrotum.

Case III.—I. M., aged seventeen years, was operated upon for large right inguinal hernia on May 25, 1894. Primary wound healing. Remained well for over four years. Did hard riding as a cavalryman in army in Spanish-American war, contracted fever, and lost over fifty pounds in weight. Relapse occurred on getting up from typhoid in weakened and emaciated condition.

I again operated on April 30, 1901, by Bassini's method, but a slight relapse occurred six months later.

Case IV.—A. B., aged thirty-five years, butcher, was operated upon for large inguinoperineal hernia on July 1, 1896. Primary wound healing. Patient had a large abdomen, with a great deal of fat in abdominal wall. Occupation required heavy lifting. Very slight relapse (size of a pigeon's egg) one year later. Truss worn for a short time. Examination four years later showed only exaggerated impulse on coughing.

Case V.—O. S., aged twenty-three years. Large, right oblique inguinal hernia. Operation September 7, 1898. Prolonged deep suppuration (staphylococcus pyogenes), with giving way of aponeurotic layer of suture. Relapsed one and a half years later.

Case VI.—I. B., aged twenty-seven years. Large, right inguinal hernia of eight years' duration, with adherent irreducible omentum. Operation July 1, 1897 (Bassini method, kangaroo tendon). Primary wound healing. Very slight relapse fifteen months after operation.

Case VII.—F. N. W., aged fifty-seven years. Right direct inguinal hernia, with large opening and very poorly-developed internal oblique muscle. Cord transplanted, but closure of canal unsatisfactory. Primary wound healing. Patient developed albuminuria shortly after operation, and his general condition became much below par. Slight relapse followed about three months after operation, and truss was applied.

Case VIII.—I. G. R., aged forty-nine years. Left oblique inguinal scrotal hernia. Operation February 7, 1900. Primary wound healing. Relapse the size of an egg, just outside the external ring, two years after operation.

Case IX.—I. W., aged nine years. Double inguinal hernia, complicated with double reducible hydrocele. Operation August 7, 1894. Double Bassini operation, kangaroo tendon. Relapse the size of a marble on right side. Truss applied. March, 1898, no sign of relapse. March, 1903, slight protrusion.

RELAPSES IN CASES IN WHICH THE CORD WAS NOT TRANSPLANTED.

Case I.—W. I. S., aged twenty-nine years. Double inguinal hernia, scrotal. Operation September 5, 1891, at Post-Graduate Hospital. Bassinis' method was used on right side, and the cord was not transplanted on the left side. Silk was used for buried sutures. The wound healed by primary union. The rupture remained cured for nine years, when the *left* side relapsed. I operated on side again April 24, 1901, at the General Memorial Hospital. The right side (Bassini) was still perfectly sound nine and a half years after operation, and remains sound at present, more than eleven years after.

Case II.—V. S., aged nine years. Right inguinal hernia of four years' duration. Truss treatment inefficient. Operation at the Hospital for Ruptured and Crippled January, 1892. Suture of canal without transplanting cord. *Buried silk sutures.* Wound healed apparently by primary union, but about two weeks later a small sinus was found, and some of the buried sutures were extruded. Relapse three months after operation. Second operation by Bassini's method, with kangaroo tendon, in July, 1902. Patient perfectly sound ten years later.

Case III.—F. H., aged ten years. Left inguinal hernia, congenital, complicated with hydrocele of cord. Operation February 15, 1892. Suture of canal with chromicized catgut. Cord not transplanted. Primary wound healing. Slight relapse in canal three and a half years after operation. Second operation October 4, 1895. Bassini's method, kangaroo tendon. Slight stitch-hole abscess. Patient has remained well since last operation.

Case IV.—H. O., aged eight years. Right oblique inguinal hernia. Operation at the Hospital for Ruptured and Crippled, December 12, 1891. Suture of canal with catgut. Cord not transplanted. Primary wound healing. Slight relapse three months after operation. Patient wore a truss for a short time; and examination, November 18, 1895, four years later, showed the hernia practically cured, only an impulse on coughing remaining.

Case V.—C. H., aged thirty years. Sliding cæcal and appendicular; hernia, large scrotal. The hernia had existed since infancy,

and could not be held by truss operation July 22, 1900. The patient had previously been under the "Miller Injection" treatment, and had had fifteen injections of irritating fluid made into the tissues about the sac. The cæcum, appendix, and a large mass of irreducible and highly vascular omentum were found in the sac. The omentum and appendix were excised and the sac sutured as well as possible in a sliding hernia of the cæcum. The posterior portion of cæcum was devoid of peritoneal covering. The cæcum was pushed back and the canal sutured with kangaroo tendon, without transplanting the cord. The wound healed by primary union, and the patient left the hospital in three weeks. The hernia relapsed about three months after operation.

Case VI.—H. D., aged four years. Right inguinal hernia, large cæcal sliding hernia. First operation New York Hospital six months before. Wound suppurated badly and healed by granulation. Recurrence soon after patient left hospital. Cæcum had slid down into scrotum, and was firmly adherent to old cicatrix. Dissection very difficult. No distinct sac. Closure of canal very unsatisfactory. Slight relapse followed six months later.

In order to estimate the percentage of radical cures after operation, it is necessary to know the period of time that must elapse before the hernia can be reasonably considered cured.

In former papers I have stated that by far the greatest proportion of relapses occur within the first year after operation, and that most of them occur within the first six months. This opinion was based on an analysis of 365 cases of relapsed hernia observed in the out-door department of the Hospital for Ruptured and Crippled, and operated upon by various methods. This series of cases showed that 85 per cent. of the relapses occurred within the first year following operation, and that 65 per cent. occurred within the first six months. I have recently, with the help of Dr. George C. Warren, late house surgeon of the Hospital for Ruptured and Crippled, made a study of 165 new cases of relapse observed since the previous statistics were compiled. This series shows that in 26 cases the interval between operation and relapse was not defi-

nitely known, leaving 139 cases as a basis for calculation. It was found that 91 (or 65 per cent.) relapsed within the first six months, and 111 (or 80 per cent.) within the first year after operation; $13\frac{2}{3}$ per cent. occurred from one to two years after operation, and only $6\frac{2}{3}$ per cent. occurred after two years had elapsed.

These new statistics quite confirm the conclusion drawn from the earlier cases, and prove that patients well one year after operation may be reasonably expected to remain well, and that after two years they may be considered permanently cured.

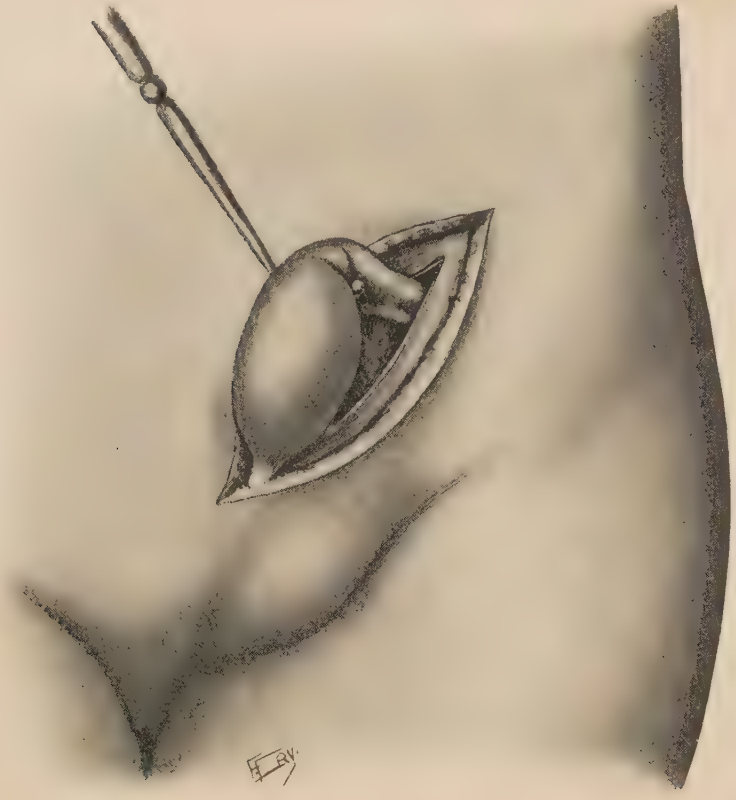
INGUINAL HERNIA IN THE FEMALE.

One hundred and eighty-one operations were performed for inguinal hernia in the female, with no mortality and without a single relapse. The method employed was practically Bassini's method for the male. The sac was always carefully dissected off from the round ligament (Figs. 1 and 2), and the latter was then allowed to drop back in the lower angle of the wound and to lie beneath the deep layer formed by uniting the internal oblique muscle to Poupart's ligament. The aponeurosis is then closed over the deep layer with a continuous suture of kangaroo tendon and the skin with interrupted catgut. That the more complicated technique of cutting up the internal oblique and transplanting the round ligament to the upper angle of the incision, suggested by Kelly, and practically an application of the original Halsted operation for the male, to the female is unnecessary, is proven by the perfect results obtained by the simpler technique described. This operation can be easily performed in from ten to twelve minutes, and I have performed it in eight minutes.

STRANGULATED HERNIA.

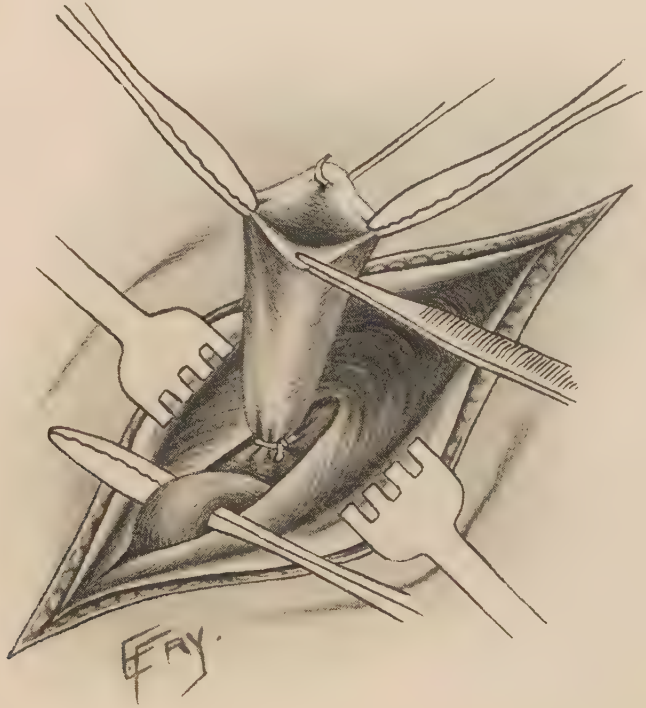
I have operated upon seventeen cases of strangulated inguinal and femoral hernia, with two deaths. One death occurred in a case of femoral hernia strangulated for three days, and in which I was obliged to resect seven inches of intestine. The other was in an infant, aged six weeks, with a strangulated hernia of the

FIG. 1.



Inguinal hernia in female. Sac unopened.

FIG. 2.

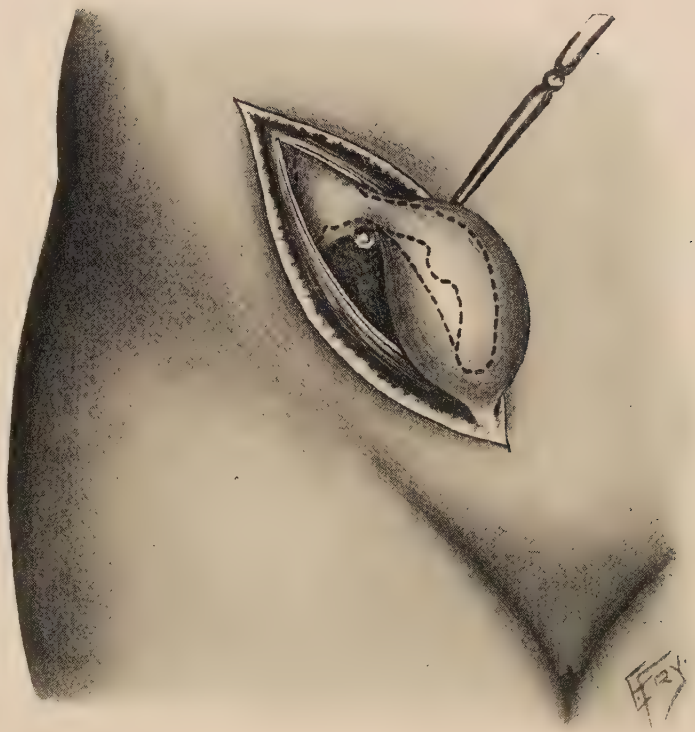


Inguinal hernia in female, showing sac dissected from round ligament.

FIG. 3.

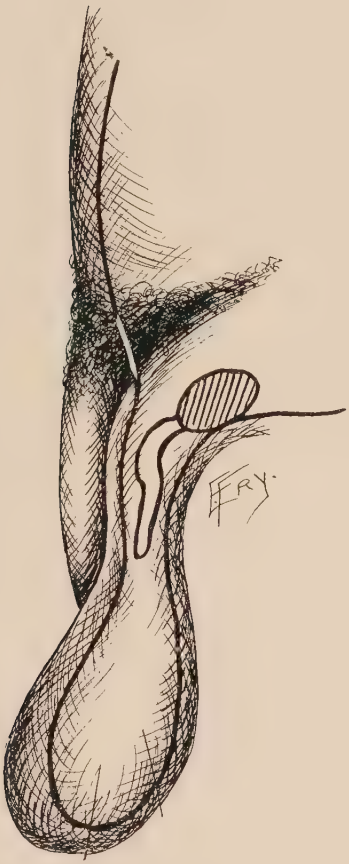
Sliding hernia of cæcum. *t* testis; *c*, cæcum; *s*, sac (acquired); *m*, hard, tuberculous looking mass at lower end of sac.

FIG. 4.



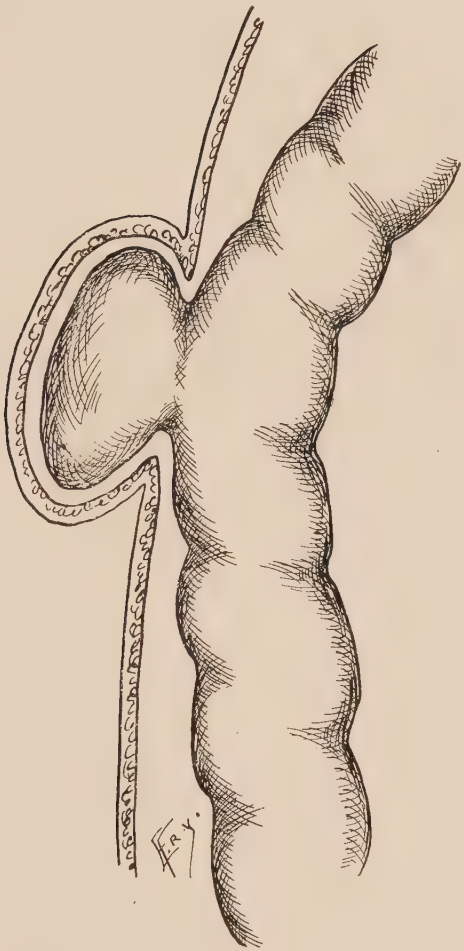
Incarcerated hernia of the appendix, with sac distended with bloody fluid.

FIG. 5.



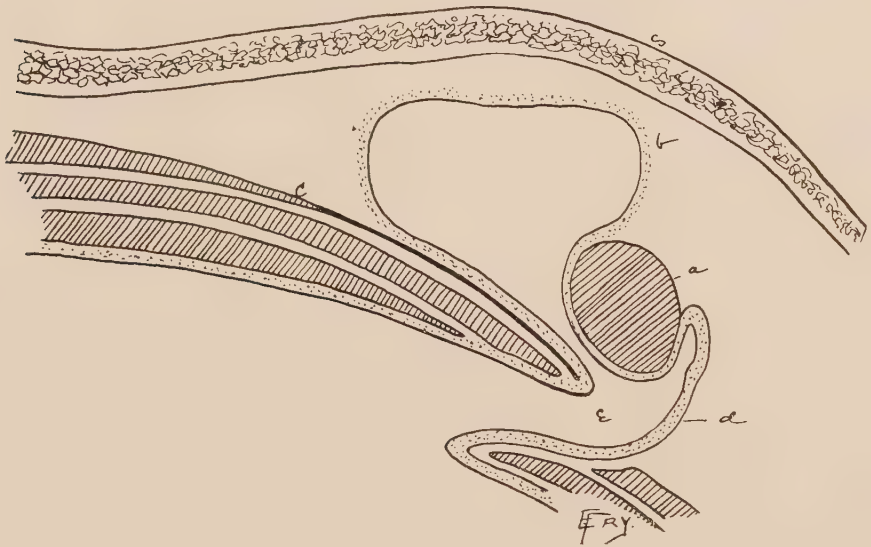
Congenital sac extending to bottom of scrotum, with testis within external ring.

FIG. 6.



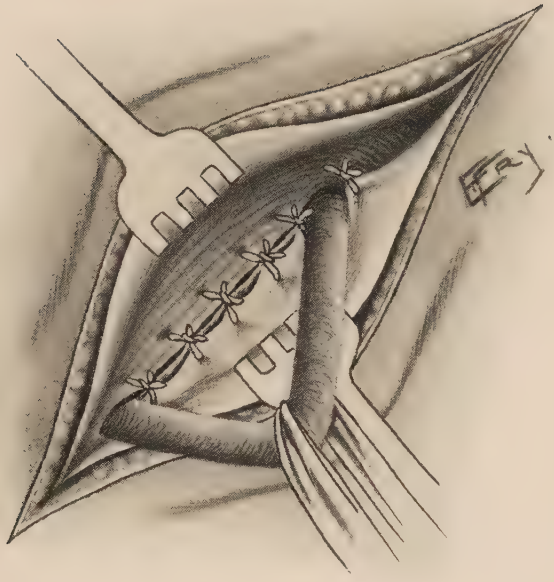
Strangulated properineal Richter's hernia. (Partial enterocele.)

FIG. 7.



Inguinal superficial hernia. *a*, testis ; *b*, hernial sac ; *c*, aponeurosis of external oblique ; *d*, cord ; *e*, external ring ; *s*, skin.

FIG. 8.



Bassini's operation (deep sutures), showing extra suture above the cord.

cæcum and appendix of three days' duration. The child was nearly moribund at the time of operation. In the remaining 15 cases a radical operation (mostly Bassini's method) was performed, and there has not been a single relapse. Primary wound healing occurred in every case. In 9 cases the patient was under the age of two years, and in 8 under one year, the youngest being an infant aged thirteen days, with a hernia strangulated fourteen hours. The patient left the hospital at the end of three days, and the hernia remains well more than a year after operation. It is important to note that in every case the strangulation was caused not by the neck of the sac, as is stated by most writers, but by the tense external abdominal ring.

HERNIA OF THE CÆCUM, APPENDIX, AND SIGMOID.

Thirty-seven cases of these varieties were observed. Of these, the cæcum was found in the sac in 10 cases, the appendix in 16 cases, the sigmoid in 3 cases (one strangulated), and in 8 cases there was a sliding hernia of the cæcum (or "Hernie par Glissement," as described by the French writers). Of these 8 cases the cæcum alone was present in 6 cases, and the cæcum with the appendix in two cases. Figs. 3 and 4 will show the condition present in this form of hernia.

OTHER VARIETIES OF HERNIA. TUBERCULOUS HERNIA.

I have operated upon 3 cases of tuberculosis of the hernial sac, 2 in children and 1 adult. In 2 cases the diagnosis was confirmed by the microscope, and in the other the clinical appearance was characteristic. In 1 case, a boy, aged six years, an operation had been performed for a large left inguinal hernia, with reducible hydrocele, in September, 1900. Nothing unusual was noted in the appearance of the sac. A few months later he developed a hernia, with fluid in the sac on the opposite side, and operation was performed on March 19, 1901. The sac was found studded with miliary tuberculosis, and examined by Dr. Jeffries, pathologist to the Hospital for Ruptured and Crippled, who confirmed the diagnosis. The patient was well when last observed, eight months later. There were no signs of tuberculosis elsewhere.

A second case occurred in a femoral hernia in a young woman, aged twenty-three years. In this case there were signs of tuberculous disease in the lungs.

HERNIA OF THE BLADDER.

I have personally operated upon but one case of hernia of the bladder. The patient was a man, aged forty-seven years. The hernia had existed for several years, and was hard to reduce and very painful when down. He had observed frequent micturition when the hernia was down. Operation was performed May 7, 1902. The bladder was not opened at operation, but was recognized in time. The patient was well January 8, 1903.

I have had two other cases of bladder hernia in my service at the General Memorial Hospital, but in both cases the operation was performed by my associate, Dr. William A. Downes.

INGUINOPERINEAL HERNIA, OR HERNIE INGUINOSUPERFICIALIS PERINEALIS (KUSTER).

This is one of the rarest varieties of hernia. Küster in 1887 (*Arch. f. Klin. Chir.*, Band xxxiv., S. 216) was able to find but 3 cases in the literature, and one of these was doubtful. In only 1 of these was an operation performed. It is always associated with perineal ectopia of the testis, itself extremely rare. Küster found only twenty instances of this condition in literature.

I have observed 8 cases of testis in the perineum, and in 6 the condition was associated with a hernia. On 5 of these patients I operated for the cure of the hernia. The sac was in every case congenital, and in four instances I retained enough of the sac to cover the testis, and placed the organ in a new pouch made in the empty scrotum; in 3 cases the testis remained in the scrotum, but in one it came out and slipped back into the anterior portion of the perineum. In one case only did I remove the testis, my first case, with a hernia the size of a cocoanut and a small atrophied testis at the bottom of the sac.

I was not conscious that this variety of hernia was so very rare until the publication of the paper of v. Moschcowitz (*Medical*

Record, January 10, 1903, p. 52), giving a history of a case and résumé of the literature. He states that only 14 cases have been reported besides his own case, 6 by Macready, 3 by Küster (who has described the condition at length (*Arch. f. Klin. Chir.*, Band xxxiv., 1887).

CASES OF INGUINOSUPERFICIAL HERNIA.

Cases I. and II.—O. H., male, aged ten years. Double superficial inguinal hernia. Testes never in scrotum. Had swelling in both inguinal regions for several years. Operation at the Hospital for Ruptured and Crippled March 20, 1902, both sides. On both sides the sac and testis were found just beneath the skin and superficial fascia, resting upon the aponeurosis of the external oblique muscle. The testes occupied a position one and a half to two inches above the external ring. The rings were rather small, and the testes could not be reduced into the canals. A typical Bassini operation was performed, and the cord was of sufficient length on both sides to permit the testes to be brought into the bottom of the scrotum, when a pouch was made with the finger to receive them. The patient was examined six months later, and the testes remained in the scrotum.

Case III.—H. V. W., male, aged thirty years, a physician. Had never seen left testis in scrotum. He had observed a swelling in left groin, for which he had tried to wear a truss, but it was always so painful that he had been obliged to take it off. Operation June 25, 1902. My notes of operation state that "testis and sac are pressing out of external ring, have turned upward, and rest upon the aponeurosis of the external oblique." The testis was brought into the scrotum. The wound was closed by Bassini's method; primary union followed, but the patient has not been traced.

Case IV.—S. S., male, aged twenty years. Double inguinal hernia, with left undescended testis. The testis on the left side had never been in scrotum, but there had been a swelling in the inguinal region for some years. Had never worn a truss. Operation at the General Memorial Hospital October 15, 1902. The

testis, with a large hernial sac, was found one and a half inches above the external ring and lying upon the external oblique aponeurosis.

DIRECT HERNIA.

Fourteen operations upon nine patients were performed for direct inguinal hernia. This is about the same proportion as shown in Goldner's statistics—12 cases in 804 operations. In most cases I transplanted the cord by Bassini's method, but the very conditions that make it possible for a direct hernia to occur—viz., an abnormally poor development of the internal oblique muscle—make it difficult to effect a satisfactory closure of the opening by any method. This is the class of cases in which Bloodgood finds "obliteration of the conjoined tendon," and advises utilizing the rectus muscle in closing the opening. As far as I have been able to trace the results there has been but one recurrence in these fourteen operations for direct hernia.

HERNIA ASSOCIATED WITH UNDESCENDED TESTIS.

In 49,859 cases of hernia observed at the Hospital for Ruptured and Crippled from 1891 to 1902 there were 400 cases of hernia with undescended testis.

Personally I have operated upon 38 patients with hernia associated with undescended testis.

The age of these patients ranged between four and thirty years. Twenty-seven were under fourteen years, and eleven between fifteen and thirty years of age.

In only one case did I find it necessary or did I deem it wise to remove the testis. This was in the case of an adult, aged twenty-three years. The testis was entirely within the abdominal cavity when the patient was lying down; yet on standing or coughing the testis could be forced into the canal.

Operation showed this peculiar and, in my experience, unique condition (Fig. 5).

A well-developed hernial sac extended into the scrotum, and yet the testis could not be drawn down as far as the external ring, even with strong traction. The large cord with dilated veins projected

fully two inches below the testis. This condition has been recently described by W. McAdam Eccles in his admirable and exhaustive lectures on "The Imperfectly-descended Testis" (*Lancet*, March 1 and 15, 1902). He states that "the explanation of the scrotal protrusion lies in the fact that a pouch of peritoneum is so frequently drawn down by the gubernaculum testis into the region of the scrotum beyond the site of the arrested organ."

The proper method of treating hernia associated with undescended testis is a question that is still unsettled. Some authorities advise removal of the organ on the ground that it is functionally of no value. Bloodgood's statistics of 459 cases of hernia operated upon at the Johns Hopkins Hospital between 1889 and 1899 show that the cord was excised in 20 cases, and that in 27 other cases castration, with excision of both testes and cord, was performed. The excision of the cord was done deliberately in 15 cases, in 13 in men over 50 years of age, and in 3 cases because the cord was accidentally cut during the operation. Castration was further performed in two children on account of injury to the cord, and in 8 other cases on account of undescended testis, with hernia. Double castration was performed only in one case—in a man with double hernia associated with undescended testes. It is stated that the testes were functionless.

Bloodgood states that Dr. Halsted believes that these undeveloped testes are important in the economy of the male, and should be preserved.

Eccles' careful study of this question (*loc. cit.*) strongly supports this opinion. His conclusions are "that, whereas there may be found in the testis two distinct types of cells, the first needed for the formation of spermatozoa, and the other probably, though it cannot be positively affirmed, required for the production of an internal secretion, failure in the development of both these types of cells will, as a rule, lead to failure in the proper bodily growth of the individual; but the development of the interstitial cells, even though there are no sperm elements, will allow the possessor to become virile while remaining sterile."

Believing in the physiological value of even an atrophied and

probably functionless testis, I have made it a practice always to preserve the organ, and have never removed it except on two occasions, the one already referred to, and the other a small and greatly-atrophied testis situated in the perineum and associated with a very large inguinoperineal hernia (size of a cocoanut). In both cases the patients were adults, and in both the other testis was fully developed.

I do not believe it wise to operate on the majority of herniæ with undescended testis in children under ten years of age, for the reason that in many cases, as the boy approaches puberty, the testis descends into the scrotum spontaneously. Formerly I attempted to anchor the testis into the scrotum by various methods, but in recent years have abandoned such attempts. The testis can almost always be drawn outside the external ring, and, if the canal is then closed by Bassini's method, the testis will not be able to get back into the canal, and in a fair proportion of cases it will later find its way to the scrotum. I have not observed a single recurrence of the hernia in these cases.

As to the danger of injuring the cord during operation, this can be avoided with reasonable care. I have never as yet met with this accident. The risk is much greater in children than in adults, as the vas is so small and delicate that it may be easily torn.

In discussing hernia associated with undescended testis, we may consider two rare varieties that owe their origin to maldescent of the testis. These are *inguinoperineal hernia* and *interstitial hernia*. Inguinoperineal or "superficial perineal" hernia, as Eccles prefers to call it, to distinguish it from a hernia through the pelvic outlet, is very rare, for the reason that it is caused by perineal ectopia of the testis, which is itself very rare. Its etiology is best explained by the presence of accessory fibres of the gubernaculum testis, which pass into the perineum and there terminate, instead of in the bottom of the scrotum as is usually the case. I have observed 6 cases of hernia of this variety, and have operated upon 5 of these cases. The first case, with a very large hernia, has been described with photograph in Dennis' *System of Surgery*, vol. ii. The patients were all adults.

INTERSTITIAL HERNIA.

I have operated upon 7 cases of interstitial hernia; 5 cases were of the ordinary variety, in which the hernial sac occupies a position between the internal oblique muscle and the aponeurosis of the external oblique. In two of the cases the hernia was strangulated—one a strangulated Richter hernia (Fig. 6) in a boy, aged fifteen years.

SUPERFICIAL INGUINAL HERNIA.

Superficial inguinal hernia, or hernia superficialis inguinalis, as characterized by the German writers, is really a variety of interstitial hernia, and is so described by Macready, and also by Eccles. Moschcowitz has recently described this variety (*Medical Record*, 1902) and reported a case. He states that only 17 cases have been reported. That this variety is not nearly so rare as these figures would lead us to believe, my own statistics show:

I have operated upon 5 cases, two adults and three children. The distinctive feature of the condition is that the sac and testis lie outside of and directly upon the aponeurosis of the external oblique muscle and just beneath the skin (Fig. 7). The development of this form of hernia is probably due to the fact that the fibres of gubernaculum testis that usually terminate in the scrotum are absent or poorly developed, and the testis, having been pushed out of the narrow external ring by the hernia behind, meeting an obstruction to further progress downward, turns upward along the line of least resistance, and rests upon the aponeurosis.

Technique Employed. In operations for inguinal hernia in the male I have tried to follow Bassini's technique as closely as possible, except that I have substituted an absorbable suture for silk. I have also, in nearly every case, placed a suture above the cord, to prevent any widening of the new internal ring in an upward direction. After the sac has been tied off well beyond the neck at a point where it has begun to widen out into the general peritoneal cavity, the deep layer of sutures are placed as follows: With a small tape the cord is held up, and the first suture is placed so

that it just touches the lower border of the cord when the latter is brought vertically to the plane of the abdomen; three to four more through the internal oblique and Poupart's ligament will suffice to close the canal to the symphysis pubis. Then the suture above the cord (Fig. 8) is inserted. The incision in the aponeurosis is then closed from above downward by a small continuous suture of kangaroo tendon, and the skin with catgut. No drainage is used, and the wound is dressed very carefully with 10 per cent. iodoform gauze, and lastly dry gauze and cotton and a spica bandage. A plastic spica is used in children under fourteen years of age. The wound is dresssed on the seventh day, and the patients are kept in bed two weeks, and allowed to go out in two and a half to three weeks, wearing a spica bandage until four weeks have elapsed, after which time no support is worn.

Suture Material. I have long been a firm believer in the superiority of absorbable sutures to non-absorbable sutures in operations for the radical cure of hernia. I have already in former papers called attention to the disadvantages of silk, silver wire, and silkworm-gut, and I will state that increased experience confirms the opinion that these disadvantages are very real. It is true that, under strict aseptic conditions and perfect technique, non-absorbable sutures seldom cause trouble, yet that they do cause trouble in a certain proportion of cases is a demonstrated fact. The late sinus formation, with or without extrusion of the sutures, tends to weaken the canal and predisposes to relapse. Catgut was used by Czerny in hernia operations, but was soon given up for silk, for the reason that it was believed impossible to perfectly sterilize catgut. By modern methods of sterilization, catgut and kangaroo tendon can be rendered absolutely sterile, and hence the only real objection to their use has ceased to exist. Yet we find the old prejudice against them still existing almost universally in Europe and very generally in this country. Silk is still used by Bassini for buried sutures, and also at the Vienna Clinic, as seen from the statistics referred to.

Silk, silver wire, and recently silk again, have been used at the Johns Hopkins Hospital.

In proof of the opinion that a large proportion of the cases of suppuration formerly attributed to catgut or imperfectly sterilized buried sutures was really due to other causes, chiefly to infection by the hands of the operator or assistants, it is only necessary to compare the results of wound healing before and after the use of rubber gloves:

Of 116 cases operated on at the Johns Hopkins Hospital prior to 1896, when gloves were not worn, there were 28 suppurations (24.13 per cent.). Of 104 cases closed with silver wire without gloves, there were 10 cases of suppuration(or 9.6 per cent.); while in 226 cases closed with silver wire, with gloves, there were only 4 cases of suppuration (1.7 per cent.). It may be taken for granted that the suture material, both silk and silver wire, in these cases was always sterile, and that the main cause for the great improvement lay in the use of rubber gloves.

That improved technique and greater facility in performing the operation may alone cause marked improvement in wound healing, the statistics of the Vienna Clinic prove. While the average percentage of suppuration in the 804 operations was 14.5 per cent., the percentage in 1895 (when the operation was first done) was 18 per cent., while in 1899, without gloves and with the same sutures (silk), the percentage of suppuration was only 5.8 per cent.

That quite as perfect wound healing may be obtained with absorbable sutures and ligatures (kangaroo tendon and catgut) as has ever been obtained with silk or even silver wire, my own statistics prove.

Wound Healing. In my series of 1003 operations for inguinal and femoral hernia, suppuration occurred in 30. In 21 this was limited to stitch-hole abscess, and in 8 cases there was deep suppuration. Prior to March, 1899, when I began to use rubber gloves for my assistants and gloves or cots for myself, there were 25 cases of suppuration (or 4.2 per cent.). Since the use of rubber gloves there have been only 5 cases of suppuration—1 deep and 4 superficial—in four years in about 400 cases (or 1¼ per cent.).

An analysis of the cases of suppuration shows that 20 occurred

in 700 cases under the age of twenty, and 10 occurred in 300 cases over the age of twenty, thus giving practically the same percentage of primary union in the children as in the adults. The largest number of cases in which suppuration occurred were observed in the year 1898, while since November, 1900, I have operated upon 170 cases of adults without a single case of suppuration.

The sutures used have been prepared by Van Horn & Co., of New York, originally by boiling in alcohol under pressure and the last six years by the cumol method, and preserved in absolute alcohol. The kangaroo tendon is chromicized just sufficiently to remain unabsorbed for about four weeks, but not long enough to cause the suture to act as an irritating foreign body and produce sinuses.

Rapidity in operating, clean dissection, especially in the separation of the sac from the cord, without bruising the tissues or allowing them to become infiltrated with blood, are also important factors in securing primary wound healing. This is well shown by two operations performed by one of our house surgeons. Though rubber gloves were worn by himself as well as his assistants, through difficulties with the sac the operation was prolonged and the tissues were bruised and blood-stained. Both wounds suppurated.

Mortality. There have been two deaths in my series of 1003 cases, or, up to March 31, 1903, two deaths in 1063 cases—a mortality of less than one-fifth of 1 per cent.

My first death—111th case—was due to ether pneumonia in a child aged six years. The second death, February, 1898, was in an adult with large irreducible omental hernia. The omentum was returned instead of being excised (as is my custom when down for any length of time and difficult to reduce). The patient developed intestinal obstruction, whether due to a volvulus or to a slowly progressing peritonitis, could not be ascertained, and died on the sixth day in spite of a second operation. Since that time over 500 operations were performed without a death. The mortality of operations for the radical cure of hernia has been steadily reduced during the past decade. Prior to 1890 it was not

far from 6 per cent., which showed sufficient risk to make one hesitate to advise operation as a routine measure.

At the Vienna Clinic there were only three deaths in 804 operations—one in narcosis, two others eleven days and fourteen days, respectively, after operation. One was due to pulmonary embolism, the other to embolism associated with varicosities in the subcutaneous tissue of the right thigh, with formation of thrombi in the varices.

At the Johns Hopkins Hospital there was but one death in 459 cases, and at Carle's Clinic, in Rome, there were but two deaths in 1400 operations upon 1285 patients, one from pneumonia on the seventh day of operation.

These statistics prove that the risk of operation for hernia at present—at least in skilled hands—is practicaly *nil*, and certainly less than the risk of strangulation, even with a hernia apparently well held by a truss.

Indication for Operation. There are certain general rules that have been observed as a guide to operation in the cases reported:

1. *Operation for Hernia in Children.* Operation is seldom advised under the age of four years, except in strangulated cases. The reason for this rule is that many of these cases, probably two-thirds, are cured by a truss. After the age of four years, in all cases in which a truss has been tried and failed, or cases in which the presence of reducible hydrocele prevents a truss from holding the rupture, operation is advised. The same rules hold good in irreducible omentum—a rare condition in childhood.

2. *Operation for Hernia in Adults.* In all adult cases under the age of fifty years, unless there are strong contraindications present, operation is advised. Between the age of fifty and seventy years operation is advised in patients in good health in cases in which the rupture is held with difficulty by a truss.

Among contraindications to operation I would mention:

1. Serious organic trouble of the heart, lungs, or kidneys.

2. Very large, adherent irreducible hernia in stout individuals, especially when the sac contains both intestine and omentum.

I believe the risks of operation in such cases are large and the chances of a permanent cure small.

When omentum alone is present the danger is less, but is still enough to be worthy of consideration. I have operated in a single month upon three patients, all weighing 240 to 250 pounds, with irreducible omentum, necessitating resection of large masses. All healed by primary union without drainage; yet one of the cases, that of a man aged fifty-five years, in which a very large mass of omentum had been removed, illustrates the dangers attending operation under these conditions.

Two weeks after perfect primary union a tender, painful area developed near the umbilicus, and the pulse and temperature began to rise. This continued for a week. Temperature: A.M., 99.5° F.; P.M., 101° to 102° F.; and the leucocyte count went to 20,400. An incision was made under ether on the tenth day after the trouble was first noticed, and the omental stump was found firmly adherent to the anterior parietal peritoneum. On cutting into the inflamed omentum, about three-fourths of an inch, an abscess the size of an egg was found and evacuated. Free drainage was established, and the wound healed slowly by granulation. If the condition had not been recognized and dealt with at the proper time—neither too early nor too late—peritonitis would probably have ensued.

There has been one death observed in the New York Hospital from the rupture of an abscess in omental stump (tied off *en masse* with silk), and Dr. Bull has reported 3 cases of well-marked inflammatory swelling in abdomen, following ligature of omentum *en masse;* but in no case was there abscess formation. In my own case the omentum was tied off in small masses with catgut, and the greatest care was exercised. I believe the suppuration due to fatty necrosis of the stump, which, in a person of more vitality, would have caused no trouble. Gloves were worn by the operator and assistants.

END RESULTS IN 1003 CASES OPERATED UPON FROM AUGUST, 1901, TO DECEMBER 31, 1902.

Of 937 cases of inguinal hernia the cord was transplanted according to Bassini's method, with kangaroo tendon for the buried sutures in 917 cases, with nine relapses (or less than 1 per cent.).[1] Of these cases 181 were inguinal hernias in the female, without a single relapse. In 20 cases in which the cord was not transplanted six relapses have been observed. This does not give a fair idea of the relative value of the method of not transplanting the cord, for the reason that in several of the cases it was used in sliding hernia of the cæcum, a very difficult variety of hernia to cure by any method.

In 66 cases of femoral hernia there was one relapse, which was so insignificant that five years afterward there was only a slight impulse that did not need a truss.

The purse-string method, originally described, I think, by Dr. H. L. Cushing, of Boston, was used in 50 cases, with no relapse; and the Bassini method for femoral hernia in 16 cases, with one relapse.

End Results in Detail. In the entire series of cases, 1003 in number, the end results were as follows: of 724 cases traced 650 were found well from one to eleven years; 708 cases were well from six months to eleven years; 467 were well from two to eleven years.

The duration of observation in these cases was as follows:

Sound over 11 years	1 case.	Sound over 4 to 5 years	75 cases.
" " 10 to 11 years	6 cases.	" " 3 " 4 "	99 "
" " 9 " 10 "	12 "	" " 2 " 3 "	157 "
" " 8 " 9 "	22 "	" " 1 " 2 "	183 "
" " 7 " 8 "	19 "	" " 6 mos. to 1 yr.	58 "
" " 6 " 7 "	29 "		
" " 5 " 6 "	47 "	Total	708 cases.

In comparing these results with recent statistics it will be seen that the period of observation is considerably longer.

The statistics of the Johns Hopkins Hospital (Bloodgood, *loc.*

[1] Since writing this paper I have found one more relapse occurring in a large direct hernia, making the total number of relapses, after Bassini's method, 10.

cit.) show that of 268 cases operated upon by the Halsted method, only 9 cases were traced more than six years, and only 124 were traced beyond one year. The recent statistics at Czerny's Clinic (*Beitr. z. klin. Chir.*, 1902, Band xxxiv., S. 450) show that of 107 Bassini operations 9 cases only were well over six years, and 106 cases over two years. The statistics of the Vienna Clinic (Albert and Hochenegg), reported by Coldner (*Arch. f. klin. Chir.*, 1902, Band lxviii., No. 1), show that of 804 Bassini operations performed from March, 1895, to December, 1899, no cases were traced beyond six and a half years; 26 were well from six to six and a half years and 434 from two to six and a half years.

At the Vienna Clinic thirty-one relapses were observed in 701 operations for inguinal hernia in the male, and four in 71 inguinal hernia in the female (or 7½ per cent.). Of 58 cases of children between the ages of one to ten years there was one relapse.

The Johns Hopkins Hospital statistics (*loc. cit.*) show that in 268 cases operated upon by the Halsted method there were six relapses, and four others in which there was slight weakness in the scar. Of 39 cases of inguinal hernia in the female there was one relapse. This gives 307 cases of inguinal hernia, with seven relapses, or, including the 4 cases of weak cicatrices as relapses (which was done in Goldner's statistics, as well as my own), eleven relapses (or 3.6 per cent.).

As I have stated, the results of the Vienna Clinic cannot fairly be cited in comparison with other statistics, for the reason that they include a very large number of operations in which no hernia was present; 804 operations were performed upon 473 patients. My own statistics show 1003 operations upon 911 patients, giving a double operation in only 92 patients, and then only when a hernia was actually present. If the same proportion of double hernia to single hernia existed in Goldner's statistics, with 473 patients, there would be 47 double herniæ or 520 operations, instead of 804, leaving the large number of 237 operations performed without the presence of a hernia. Up to the end of 1898, or all except one year of the entire period covered by the Vienna statistics, it was the custom to operate on both sides "in all cases in which

there was a widening of the external ring.'' The reason for this procedure was the fear that a hernia would develop on the other side, but the after-examination of 52 cases operated on unilaterally showing only 4 cases of hernia on the opposite side, the double operation was abandoned in 1899, except in cases in which a double hernia was present.

DISCUSSION.

Dr. Alexander Hugh Ferguson, of Chicago.

In oblique inguinal hernia the protection of the internal ring is always lacking. The internal oblique muscle is its chief guardian, and when it does not perform that function it is on account of its deficient origin at Poupart's ligament, and then does not come properly over the ring and furnish the muscular protection that is present in a normal inguinal region. That the internal oblique has a deficient origin at Poupart's ligament in oblique inguinal hernia there is no longer any room for doubt. I have demonstrated this fact by accurate measurements on the operating-table in several hundred cases. Bearing this in mind the key to a radical cure is to suture the internal oblique to the inner aspect of Poupart's ligament, thus bringing a powerful muscle completely over the internal ring, which specially protects it during violent exertions that increase intra-abdominal pressure. The steps of an anatomical or typical operation are (*a*) ablate the sac; (*b*) take up the slack of the transversal fascia at the internal ring by separate or combined sutures; (*c*) sew the internal oblique muscle to Poupart's ligament; (*d*) suture the aponeurosis of the external oblique; and, finally, (*e*) coapt by suture of the skin.

It will be observed that the normal relationship of the structures is not disturbed; hence it may be truly called an anatomical or typical operation. There is no anatomical, physiological, or valid surgical reason for tearing the cord from its bed, as is done in Bassini's operation.

When the conjointed tendon is deficient, as it often is in direct hernia, and also when the whole hernial region is thinned out, a plastic operation may be indicated. For the former I borrow from the rectus muscle, after the method of Bloodgood, and for the latter I utilize the sartorius muscle.

Since I began the typical operation, now over six years ago, I have yet to see a return. The cases of my friends added to my own now number well over a thousand.

Dr. Coley. The question raised by Dr. Ferguson is not a new one, and at the Hospital for Ruptured and Crippled Dr. Beal and myself have been operating by this method, described by Dr. Fergusson, since 1892, having used it in over a hundred cases. My own series of cases of radical cure in the female, without the transplantation of the round ligament, might be used as evidence in favor of Dr. Ferguson's contention. Personally I am inclined to continue the transplantation of the cord in the male as I have done heretofore, as the operation is not any more

difficult; it can be done in ten minutes, and I see no reason for shortening the operation by not transplanting the cord. My results have been so nearly ideal that I do not feel like giving it up. In my own cases there have been a greater proportion of relapses when the cord has not been transplanted than when it has.

REPORT OF A CASE OF GANGRENE OF FIFTEEN INCHES OF CÆCUM AND ILEUM AFTER AN OPERATION FOR APPENDICITIS.

Relief of Artificial Anus after Repeated Operation.

By N. P. DANDRIDGE, M.D.,
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The case which I have to report is one in which extensive gangrene of the ileum and cæcum followed an operation for appendicitis. After some weeks a lateral anastomosis between the small intestine and transverse colon was made in hopes of relieving the artificial anus. This proved to be entirely inefficient, and an end-to-end anastomosis with the Murphy button was then tried. This was partially successful, but left a fecal fistula. The fistula was finally and permanently closed after two more operations.

During March, 1901, I was asked by Dr. Jos. Eichberg to see a man, aged twenty-six years, with appendicitis. Within two years he had had eight mild attacks; the present attack had commenced ten days before; the symptoms had been persistent, but not severe. The temperature at the examination was 101.4° F., the pulse slightly above normal, and there was little distention. There was a marked tumor in the region of the appendix. The tumor was not sensitive, but there was rigidity of the right rectus.

The operation was made March 31st, temperature and pulse having somewhat increased. On opening the cavity the appendix could not be found. We came, however, on a mass to the inner side of the colon, above the ileocæcal valve, beneath the peritoneum and lying on the psoas muscle and overlapping its inner edge.

It was thought to be a mass of exudate about the appendix, and its enucleation was attempted after walling off the general cavity.

When partly freed, a pulsating artery of some size was seen to enter and pass through the mass. It was necessary to ligate the vessel before removal was complete. The parts removed proved to be some enlarged glands, somewhat larger than a hen's egg, and were supposed to be some tubercular iliac lymphatics. This view, however, was not sustained by a subsequent microscopic examination, and they were doubtless enlarged mesenteric glands, as the sequel proved. The appendix, after some search, was found behind the cæcum and removed. It was three inches long, reddened and thickened, without adhesions. It was club-shaped, with a stenosis near the cæcum. No pus was found. The incision was closed without drainage. There was a good deal of nausea after the operation. The bowels were moved on the third day by castor oil, followed by an enema. The temperature became normal, the pulse ranged from 64 to 70, and the bowels moved naturally and freely. On the seventh day some of the stitches were removed and the wound found closed throughout, and the general condition was entirely satisfactory, some dragging sensation only being complained of if the patient turned on the right side. On the evening of the eighth day severe pain came on in the right side, and during the night the dressings suddenly became saturated with a thin, fecal fluid, and were changed. The next morning the fresh dressings were again stained, and gas and thin feces were seen escaping from the upper end of wound. This was spread open with forceps, and at once some gangrenous tissue presented at the opening. All stitches were then removed. By night the entire wound had opened out, and the gangrenous anterior wall of the cæcum, about three inches in extent, protruded, feces escaping from several openings. This was removed by scissors. The next day a further protrusion occurred, and was later removed. After a day or two a section of ileum, nine inches long, was washed out of the wound entirely gangrenous. A complete artificial anus was established, only a small amount of scybalous matter being obtained by the first enema; the other enemas discharged partly by the side, or were returned unchanged. The condition of the patient was for some days very critical. Some pus appeared in the wound, and for

some days there was fever. A drainage tube was, however, inserted into a pocket, and with this drainage the pus and fever disappeared. The condition gradually improved, and the wound showed healthy granulations and began to contract, so that the opening in the small intestine could be seen discharging feces. These at times became thin and acrid, excoriating the skin. Opium, bismuth, and magnesia were necessary to control this condition. The bowels moved from four to six times a day, and the dressings consisted of large masses of gauze covered with cotton and kept in place with a body binder.

At the end of seven weeks the general condition was so good that it was determined to try a lateral anastomosis between small intestine and colon, in the hopes of side-tracking the greater part, if not all, of the fecal current, and so render a direct operation on the artificial anus easier and safer at a future time. The direct operation at this time was not deemed feasible.

The abdomen was opened to the left of the median line. The abdominal cavity was walled off on the right side, but otherwise free from adhesions; the ileum leading to the right fossa for some inches was reddened and thickened. The anastomosis was made with the O'Hara forceps between the ileum—eighteen to twenty inches from where it entered the adhesions—and the transverse colon. An acute angle at the point of juncture was secured by uniting with sutures the two limbs of the loop of the small intestine. The abdominal wound was closed without drainage; union promptly took place, but was followed by a serious stitch abscess, which was accompanied by fever for some days. So far as relieving the artificial anus, the lateral anastomosis was an entire failure, for, while for a time discharges from the rectum were secured, the discharge from the side was not materially lessened.

During the summer nutrition improved and weight was gained. In August a small phosphatic calculus was passed, and pus corpuscles found in the urine. Several similar masses were passed, and attacks of pain, with swelling in the left side, with fever, left no doubt of the existence of a calculous pyelitis. In October a material change was found to have taken place in the side. The contrac-

tion of the wound had drawn up the end of the ileum above the level of the skin, the mucous membrane was everted, and a vermicular movement could be seen preceding the discharge of feces. The end of the small intestine was surrounded by a firm cicatrix, except at the upper part, where a sinus led down to the opening in the large intestine, somewhere deep down in the iliac fossa. It was determined to unite the ileum and colon end to end by a Murphy button, and so establish the absolute continuity of the bowel, all discharges by the rectum having ceased for some weeks.

This was accomplished with difficulty, both ends of bowel being irregularly thickened and the small intestine being absolutely devoid of normal peritoneum. Gauze was placed on either side of the union, and about two inches of the incision left open. On second day gas escaped from the rectum, and on the fifth two free stools. The day following a little fecal fluid came from the side, and a fecal fistula was established, from which a part of the contents of the intestine continued to escape; daily discharges of much the greater part, however, came from the rectum. Granulation of the wound took place rapidly until the fistulous opening was only large enough to admit a large probe. During this time a serious attack of pyelitis developed. All pus disappeared from the urine, while pain, swelling, and tenderness, with fever, developed over the left kidney. After some days a notable quantity of pus appeared in the urine, and the above symptoms all at once disappeared. Two further attempts were made to close the fistula, with the effect each time of making the discharge freer for a while, with, however, rapid closure and diminution. A colostomy pad succeeded in diminishing this still more, and added greatly to the patient's comfort. Final closure was accomplished by pressure from a rubber sponge held in place by an elastic bandage around the body. It is now over fifteen months since final closure took place and the man is engaged in active business.

The Murphy button has never been heard from.

DISCUSSION.

Dr. A. J. Ochsner, of Chicago.

These cases are very interesting, and there is one point I wish to discuss in reference to the Murphy button. It has been found that in order to succeed with it it must be placed in healthy tissue. When it is placed in cicatricial tissue, or in tissue in the vicinity of a tuberculous infection of the intestine, or in tissue which is not well nourished, it will invariably fail. In this operation it is much better to remove the lower portion of the cæcum or to cut off a portion of the ileum, so as to get back as far as necessary, and then to make an end-to-side anastomosis between the ileum and the ascending colon or to any other portion of the colon which is perfectly healthy.

Dr. G. R. Fowler, of Brooklyn.

I am partly responsible for the original suggestion of implantation of the intestine for the purpose of short-circuiting the latter in the cure of fecal fistula in the cæcal region. In my opinion there are two very serious errors in the technique of Dr. Dandridge, to which are to be attributed the failure of this measure in his case. First, as to implantation in the transverse colon. While theoretically it is desirable to maintain the fecal current as normally as possible, still experience in these cases shows that implantations made in the sigmoid are better; no bad results follow the direct passage of fecal matter from the small into this portion of the large intestine. Unless the occlusion of the small intestine between the site of the fistula in the cæcal region and the point of implantation in the sigmoid is made there will be very little benefit obtained from the operation. The occlusion can be done by silk or silver wire. In a case of small fistula the former may suffice, particularly if an early plastic operation for the closure of the fistula is contemplated. Where a longer occlusion will probably be necessary, as in the case of a larger fistula, silver wire should be used. With the operation of ileosigmoid implantation and circumclusion of the small intestine between the site of the fistula and the point of implantation, performed in this manner, no fecal matter can reach the former. Several of my cases have closed spontaneously after this operation.

Dr. Dandridge. I confess it was my intention to carry out Dr. Fowler's suggestion, but the sigmoid flexure had a very short mesentery, and it was not very convenient to bring it up. It was very readily accomplished, however, with the transverse colon.

When the anastomosis was made I hesitated a moment, as I did not feel like burning all my bridges behind me. Another time I shall not bother about the lateral anastomosis at all, but shall allow sufficient time to elapse, and then go ahead. For many weeks the ends of the intestines could not be identified at all, but finally the contraction was so great that the operation was made without injuring the peritoneum.

THE SIGNIFICANCE OF ALBUMIN AND CASTS IN SURGICAL PATIENTS.

By JOHN C. MUNRO, M.D.,
BOSTON.

The statement of a surgeon of considerable experience, that he would not operate in the presence of albumin and casts, except in cases of great necessity, excited the writer's curiosity to investigate the prevalence of these indications of renal disturbance in recent surgical patients at the Boston City Hospital.

The report must be considered as barely more than preliminary in character. To carry out such an investigation to its full completion would mean years of observation of individual patients in large numbers—a task almost impossible when dealing with charity patients. If the statements of life insurance examiners that temporary albumin in the urine does increase the risk, even though to a slight degree, it must in the same way influence the later histories of our surgical patients. That it influences the immediate history, however, of patients suffering from surgical disease is extremely doubtful.

There is danger, without doubt, in operating upon a patient whose kidneys are incapable of sufficient elimination and where there are secondary organic changes. But because a patient exhibits a small amount of albumin, hyaline and fine granular casts, with renal cells, the conclusion should not be hastily made that he is not a fit subject for operation. Definite contraindications in the way of deficient elimination, vascular degeneration, or other organic changes must be present.

On the other hand, to avoid the mistake of being too casual,

the presence of any renal danger signals should make one take heed lest he overlook concealed or unsuspected serious lesions.

Five hundred cases showing albumin and casts in the urine (admitted within the last two or three years into the surgical wards) have been roughly analyzed. Altogether 4185 cases were considered. Of these none that showed obvious renal degeneration or glycosuria has been included; nor have patients suffering from genito-urinary disease, burns, erysipelas, or similar diseases been included. We found, first of all, that approximately a good 35 per cent. of all patients treated in the surgical wards showed signs of renal trouble. This is probably a fairly accurate proportion of surgical patients in whom we must expect to find albumin, casts, etc. Indeed, we believe this percentage is below rather than above what we should look for, because it is not rare to find a record made by the house officer of "negative urine" where an attached urine chart shows that albumin and casts have been found. In other words, the significance of small traces of albumin, with or without casts, may be of so little value in the average patient that the house officer dismisses the findings as of no importance, especially where the progress of the case has been uneventful.

Practically every form of injury and disease is included in the present 500 cases, the majority being of serious nature. At least 60 per cent. underwent operation. About 12 per cent. suffered from fracture. In this connection it is of interest to note that these patients, with few exceptions, were etherized, many for operations of length; yet there is nothing to indicate that any renal damage was inflicted by the anæsthetic.

The urine examined was that which was passed soon after entrance to the ward. The accuracy of the examinations varies more or less with the ever-changing house officer. Undoubtedly rare casts and cells were frequently overlooked in the pressure of work. The quantity of albumin varied from the slightest possible trace to $\frac{1}{8}$ per cent. In sixteen cases $\frac{1}{4}$ per cent. was recorded; in some of these the quantity diminished later to a trace or disappeared entirely; in others amyloid disease was probably

present. Occasionally no albumin was found, although casts were recorded.

In about half of the 500 cases casts are definitely recorded, probably less than the actual proportion. Blood and pus occurred very often, especially in the urine of women. Fatty casts and blood casts were not infrequently noted, but apparently they bore no special significance. The twenty-four-hour quantity of urine was not included in the reports of any of these cases. Patients, as a rule, who required special attention in this regard were eliminated from the present inquiry, as there were suspicious or marked renal or genito-urinary lesions.

In brief, we were curious to determine how much apprehension we should feel when about to operate upon patients without obvious renal degeneration passing plenty of urine, of good specific gravity, in which a trace of albumin with casts is unexpectedly found.

To take up in detail certain points, we found that about 10 per cent. of the cases occurred in children under fifteen years of age. This was a much larger proportion than was expected; and as only 8 per cent. of all patients treated at the hospital are children under thirteen years of age, it makes the proportion astonishingly large. Furthermore, we find that 44 per cent. of the cases were between the ages of sixteen and thirty-five years—the time of life when albumin, at least in non-surgical patients, is supposed to be comparatively rare. Between thirty-five and sixty years of age we find 36 per cent. of the patients, and about 10 per cent. were over sixty. What the relative proportion of the various decades bears to the ages of the 4185 patients was not determined; but in whatever way it is considered, the relative and actual number of children is higher than anticipated.

The cause of the albumin and casts is difficult to determine. Nearly a quarter of the patients over fifteen years of age entered the hospital for some form of traumatism, and presumably the renal trouble was present at the time of injury. It is fair to infer that the children were active and well at the time of the injury that brought them to the hospital. Possibly alcohol is a factor

in the renal irritation, because it would seem to be almost the exception for an adult patient (male or female) not to use alcohol to some extent. Many are steady drinkers, some drink to excess. Whether this alone, or the combination of alcohol, insufficient or improper food, and hard work, is enough to cause the requisite irritation, it is difficult to say. It is certainly suggestive. Sepsis, unhygienic surroundings, and improper clothing are probably factors in causing albuminuria in children. In a few cases—too few to be more than suggestive—the albumin and casts that were present in the first specimens of urine passed, disappeared in subsequent specimens—sometimes after operation, sometimes in cases not operated upon. A number were found in septic cases—appendicitis, etc.—where the renal disturbance seemed due to the sepsis subsiding as soon as drainage was established by operation. The effect of simple food, rest, and warmth must be considered as well. It is quite possible in non-septic cases, anxiously awaiting operation, that a temporary albuminuria may be caused by the mental disturbance in a way similar to that in which cardiac murmurs are not infrequently caused.

Of the 500 cases tabulated 63 died. These will be considered later. In the remaining 437 patients the natural query is whether convalescence was influenced in any way by the presence of albumin and casts. So far as could be told from a general review, without carefully analyzing each case in detail, convalescence seemed to be such as one would expect under the general circumstances—in other words, normal recoveries were as satisfactory as could be desired. Where there were complications or set-backs there was adequate explanation on grounds independent of any renal lesions.

In the sixty-three fatal cases casts were absent or not seen in 30 per cent.; eight patients died from shock. Of these one patient aged seventy-two years, with advanced carcinoma of the breast, died almost immediately after a long operation. It is barely possible that a slight renal lesion had some influence on the result. Two died after operation for general peritonitis, one each from multiple injuries, operation for appendicitis with profound

sepsis, typhoid perforation, hemorrhage following common duct operation, and septic pelvic abscesses—all potent causes without the slight effect from kidneys doubtfully damaged. There were five deaths from pneumonia, three from tuberculosis, nineteen from general sepsis or severe peritonitis, where there could be no doubt as to the infection alone being a legitimate cause of death. In addition, there were deaths from embolism, malignant disease, cardiac disease, skull fractures, and pancreatitis, where the rôle of the urinary organs must have been insignificant. Of four cases in which death was ascribed to senility, one, with cellulitis of the arm, had ¼ per cent. of albumin and casts, one with intestinal cancer had profuse diarrhœa, one had a strangulated hernia, and the fourth died one month after a fracture of the femur, showing only the slightest possible trace of albumin with hyaline and granular casts.

To glance at the record of the examination of the kidneys in twelve cases that came to autopsy, not included in the group just discussed, we find that one case of portal pylephlebitis showed fatty degeneration of the kidney; another similar case had normal kidneys, as did a patient dying of gastric carcinoma, sarcomatosis, rupture of the liver, and compound fracture of the leg. Fatty degeneration was found in a case of general peritonitis and sepsis and in a fractured pelvis with pulmonary embolism. A left pyonephrosis was found in a case of abscess of the liver. A chronic passive congestion in a case of osteomyelitis with pericarditis and an amyloid kidney was found in a case of general peritonitis. With the possible exception of the patient dying after breast amputation and the old man dying with cellulitis of the arm, it requires a long stretch of the imagination to give any weight to the urinary conditions in the fatal result of these sixty-three cases.

In conclusion, we should expect evidence of renal irritation in over a third of the surgical patients found in a municipal hospital. The mere presence of a trace of albumin, with or without hyaline and granular casts, unattended by other evidence of renal damage, should not influence the prognosis in surgical disease or operation.

The presence, however, of albumin and casts should place us on the watch for other and more significant signs of organic degeneration, which may prove serious obstacles to operation or satisfactory convalescence. Furthermore, albumin and casts alone are apparently no contraindication to the administration of ether. The age at which we must expect albumin and casts in surgical patients is under thirty-five years in over half the cases. The proportion in young and otherwise healthy children is probably as great as in adults.

DISCUSSION.

Dr. John B. Roberts, of Philadelphia.

Dr. Munro has advanced a view which has rather shaken my previous opinion. If I have found a trace of albumin with casts, I have heretofore considered the cases were bad for ether. I viewed them as probably cases of contracted kidney, and, therefore, poor subjects for operative procedure because of the possibility of suppression of urine.

Dr. N. B. Carson, of St. Louis.

I can hardly speak intelligently upon this subject, as I have not analyzed and tabulated my cases as Dr. Munro has, but my experience has been altogether different from his. He encourages me to proceed in cases that I would otherwise pass over and not operate upon if it were possible to avoid it. When I find cases of diminished urination with increased specific gravity and a greater or lesser quantity of albumin, with hyaline or other casts and kidney cells, I avoid operation if possible, because my results have been so unfavorable. This is especially true in septic cases and in cases of appendicitis. Probably the cases of appendicitis where I have simply opened the abscess cavity and drained, thinking of nothing but emptying the cavity, avoiding the long administration of ether or chloroform, and getting my patient off the table as soon as possible, were often the kind he mentions; but in these cases I have had so many unfavorable results that I avoid operation if possible. I believe my mortality in these cases has been 50 per cent., and I recall quite a number where I have simply opened the abscess, and the patient has been off the table within twenty minutes. These careful observations of Dr. Munro are very interesting, and I shall take up the study myself and compare my results with his.

Dr. F. H. Gerrish, of Portland, Maine.

I would like to know what method of testing for albumin Dr. Munro adopted in these cases. There are certain methods of testing for albumin where a very slight amount would not be found, and it depends whether or not exceedingly minute tests are employed.

Dr. M. L. Harris, of Chicago.

The frequency with which casts are found in the urine depends entirely upon the examiner. If a sufficient number of examinations were made hyaline casts would be found almost universally. The present methods of centrifuging urine will show in the majority of cases that

a few hyaline casts are present, and in my own work I have disregarded entirely the presence of a few casts with a trace of albumin, provided the amount of solids is up to normal. Formerly, where a trace of albumin was present with hyaline casts, I used chloroform; but since the report on a large number of examinations has shown that chloroform is followed by albuminuria in more cases than ether, I have disregarded it and used ether, unless there is some other contraindication than the mere presence of albumin.

Dr. Munro. I am very glad to have called out this discussion, and I am sure nobody is more astonished than I was when I summed up the total results. It does not seem as if these cases could have contracted kidneys. The presence of albumin in septic cases, from what I could gather where the records of the urine examinations were kept up after operation, is suggested, as it disappeared after operation and drainage of the sepsis. Whether this observation has any important connection or not, I cannot tell. Of course, in Boston ether is the predominant anæsthetic, but in these cases it had apparently no effect upon the course of the case. Taking all the cases that come to the hospital, including traumatic, septic, and pathological cases, the mortality is about 12 per cent.; and I cannot believe that the presence of albumin affects the results, as our mortality is about what it is in all large hospitals. Dr. Gerrish asks about the method employed, which is for the most part the nitric acid and boiling tests. Cases with reports of clouding from mucin, etc., are excluded from my paper. Our examinations are made by recent medical graduates. I am personally afraid of a very low specific gravity. The cases reported here are those which had a normal specific gravity, and, as far as we know, they were passing the normal amount of urine. I was very glad to hear Dr. Harris' remarks, as it seems to me that hyaline casts are much more abundant than we suspect.

THE TREATMENT OF ANEURISM OF THE EXTERNAL ILIAC ARTERY BY DIGITAL COMPRESSION, WITH REPORT OF A CASE.

By FRANCIS J. SHEPHERD, M.D.,
MONTREAL, CANADA.

The methods of treating aneurism have been many and various. In the time of Celsus the tumor was cut into, and, to arrest the frightful hemorrhage which resulted, a heated iron was thrust into the wound. Rufus and Antyllus cut into the aneurism, cleared out the contents, but previously tied the vessel above and below the aneurismal dilatation. Morel (in 1674) introduced the tourniquet, and this prevented the very severe hemorrhage which always resulted from opening an aneurismal tumor, and enabled the operator to tie, at least temporarily, the vessel.

The surgical operations for the cure of aneurism were so dangerous that, in cases where the aneurism occurred in the extremity, amputation above the aneurismal tumor was often resorted to in preference to interfering with the aneurism itself. Anel (in 1740) first showed that it was not necessary to open the tumor to cure the aneurism, and he cured a case of aneurism at the bend of the elbow by ligating the artery above the tumor and without opening the sac.

To John Hunter we are much indebted, for he first taught that it was not essential, in order to cure the aneurism, to arrest the flow of blood completely, but only, as he said, "to take off the force of the circulation;" and thus he showed that if the artery were tied some distance above and where it was healthy, a cure would result.

Although pressure directly over the aneurism has been applied for the cure of aneurism from time immemorial, it was not until

the establishment of the Hunterian operation that pressure was applied to the artery above the aneurismal sac. At first this was not a successful treatment, chiefly because it was applied too energetically and resulted in pain, inflammation, and sloughing of the compressed parts, and was practically abandoned as a mode of treatment. Later, however (about 1825), the treatment by compression was resorted to again, but in a more scientific way and with better instruments, such as those of Signoroni, Hoey, and, later, that of Carte and others. The pressure was neither severe nor constant, was maintained only as long as it could be conveniently borne by the patient, and as soon as there was swelling, numbness, throbbing, etc., the pressure was reduced or removed altogether. When the tissues had regained their normal condition the pressure was reapplied. In this way the circulation in the tumor was reduced and coagulation favored; the tumor usually diminished in size, became harder, and ultimately, in a favorable case, the pulsation would disappear altogether. It was not necessary that the pressure should always be at one point, and sometimes two instruments were used; one was slackened and the other screwed tight so as to compress the vessel, and *vice versa*.

Digital compression was first employed as a sole method of treatment by Dr. Knight, of New Haven, Conn., in 1848, and was successful. Vanzetti, of Padua, reported cases successfully treated by this method in 1853–5, and he claims priority in the method, for he treated a case of popliteal aneurism by digital compression in 1846. It is no doubt chiefly due to Vanzetti's advocacy of this form of compression that it was so generally adopted.

The advantage of digital compression is that no apparatus is necessary, the finger being the sole means by which the artery is controlled above the aneurism. It is necessary to have relays of assistants in order to effectually employ this treatment. It can be better undertaken where there is a medical school, and where intelligent students can be made use of to carry out the treatment. The vessel is compressed by the finger, and as soon as one person

gets tired he is replaced by another, who compresses a little higher up or lower down. Few care to keep up the compression more than five or ten minutes at a time. Continuous compression can thus be kept up for many hours by having shifts of a dozen students alternating with one another. The part to be compressed should be carefully shaved and dusted with powder. After pressure has been applied for a time the patient may feel much pain, and this should be controlled by a hypodermic injection of morphia. Twenty-four hours is usually sufficiently long to keep up the compression, and in the case reported below the pulsation ceased completely in the aneurism in twelve hours.

It is the fashion at present, as perhaps it has always been, to run after new methods of treatment, and to forget that there is anything good in the old. Now, digital compression in some cases is of great value, and, even if it fails, does not interfere with the employment of other measures later on. In the form of aneurism in which it was tried in the case reported below it is especially of service, and, if successful, prevents the patient running the risk of a most serious operation. I refer to cases of inguinal aneurism involving the femoral and external iliac artery.

In this case the man first of all objected strongly to a cutting operation; secondly, the aneurism extended up so far that it was thought that if any ligature of a vessel were undertaken, it would have to be the common iliac. The good results in this case fully justified the reasonableness of the treatment.

John H., aged forty-three years, married, founder by trade, was admitted into the Montreal General Hospital on August 19, 1902, complaining of a swelling in the groin. The patient has lived in Montreal for the past ten years; before that he lived in England. Is a moderate-sized, well-built man; never has had any severe illness; never had venereal disease in any form; is a very moderate smoker, and uses alcohol very rarely.

History. He strained himself lifting a heavy weight some months ago. About two months ago noticed a swelling in the groin, which pulsated and was soft and painless. This swelling

gradually enlarged and became harder, and seemed to grow upward into the abdomen. Now there was difficulty in stooping, pain, and some swelling of the limb; but he worked up to the time of his admission. Of late he had not noticed much increase in the size of the tumor.

On admission the following note of the condition of the tumor was made: In the right groin, and extending upward in the course of the external iliac artery, is a fusiform swelling which has all the characteristics of an aneurism—pulsates, and the pulsation is distensile. On pressing deeply in the iliac fossa above the tumor, the pulsation in the tumor is arrested and the sac becomes flaccid. On removing pressure, pulsation is resumed. The tumor feels bilobed on palpation, the smaller part forming the lower lobe. This partition of the tumor is evidently due to Poupart's ligament stretching across it. It seems to extend some three inches above Poupart's ligament, and on deep pressure its upper limit can be made out and appears to overlap the artery.

The patient objecting to operation, it was thought better to try palliative means until the session opened and relays of students could be obtained for digital compression. So he was put on Tufnell's treatment, and ice-bags applied over the tumor. He was given iodide of potassium internally and very little fluid. In a couple of weeks there was a marked decrease in the size of the tumor, and the pulsation did not seem so strong. The tumor now appeared to be a little larger than a hen's egg. It remained stationary after this, and did not decrease further. By the end of September, the students having returned, digital compression was commenced. The parts were shaved and washed with alcohol, and dusted with talc powder. Students were divided into three groups of twelve, each group being on duty eight hours, each student compressing the artery for five minutes. At the end of twelve hours pulsation had entirely ceased, but compression was continued in a more moderate degree for twelve hours longer. After the first four or five hours the patient complained bitterly of pain, although there was no excoriation at points of compression. The pain was easily controlled by hypodermic injections

of morphine. After twelve hours the patient had no more excessive pain—in fact, was comfortable. His leg was now wrapped in cotton-wool and carefully bandaged.

The patient was kept in bed a couple of weeks more, and all this time the tumor was contracting and hardening. I saw him six months after his leaving the hospital, and, although the tumor could be easily felt, there was no pulsation and it was very hard.

I saw a similar case treated successfully in this way many years ago by the late Professor Fenwick, of McGill University, and it was this that induced me to make a trial of the treatment by digital compression in this class of cases.

DISCUSSION.

Dr. Richard H. Harte, of Philadelphia.

I am glad Dr. Shepherd has brought forward this mode of treatment. I had the privilege of taking charge of a number of these cases for the late Dr. Agnew, and I consider the method a good way of dealing with aneurisms where you have a large number of students to fall back upon; but you cannot do it unless you have intelligent assistants, of whom it takes a great many. You have the advantage that if you fail to cure the aneurism by compression the method establishes collateral circulation, which is so very necessary when the ligature is resorted to. I recall one case which was cured in thirty-eight hours, and another in sixty hours, while a third failed in 120 hours. The man finally had to be operated upon, and the vessel was ligated. He had a secondary hemorrhage, and the vessel was tied higher up. A third hemorrhage followed, which finally caused his death. Undoubtedly in this case the vessels were very bad. Although this method of dealing with aneurisms has apparently dropped out, I consider it an exceedingly safe and valuable one. Like many of the old things which are exceedingly good, it has been revived.

Dr. J. F. Binnie, of Kansas City, Mo.

I did not understand whether the compression in the case reported by Dr. Shepherd was applied centrally or peripherally.

Dr. Joseph D. Bryant, of New York City.

The remarks thus far would seem to indicate that this method requires sections of students or other persons; but in several cases I have been quite successful in arranging a weight by which one person, or even the patient, could regulate the amount of pressure and effect a cure.

Dr. Shepherd. In reply to Dr. Binnie's question, I may say the pressure was made in the right iliac region, about the level of the sacro-iliac synchondrosis. He advocated this method in certain cases, where, for instance, operation was refused, or in cases of aneurism of the external iliac, where a serious operation was avoided if the procedure were successful, and, if not, then operation by ligature could be performed afterward. In abdominal aneurisms it was very difficult to control the vessel by pressure.

TWO CASES OF LEFT DUODENAL HERNIA, IN ONE OF WHICH THE SAC CONTAINED THE ENTIRE SMALL INTESTINE, THE CÆCUM, AND A PORTION OF THE COLON, WHICH WAS STRANGULATED.

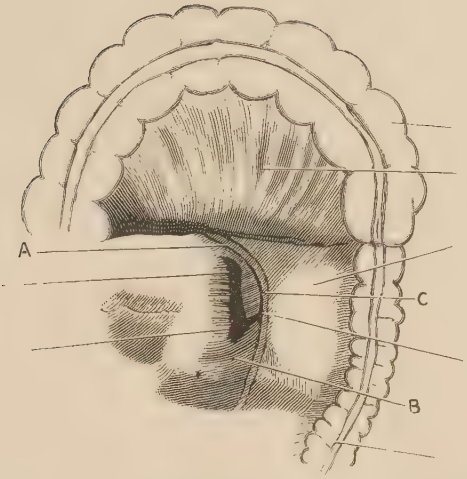
By LEONARD FREEMAN, M.D.,
DENVER, COLO.

The abdominal viscera and peritoneum are subject to various malformations and malpositions, sometimes acquired and often congenital. They were formerly regarded as mere anatomical or pathological curiosities; but with the growth of abdominal surgery they have acquired a new significance. This is especially true of the peritoneal fossæ and of the irregularities in form and position of the colon, cæcum, and vermiform appendix. Unless the surgeon be familiar with these unusual phenomena, his diagnostic ability will be curtailed, and he may at any time be confronted by confusing conditions for which he can find no adequate explanation.

The peritoneal fossæ, for instance, may be responsible for the most remarkable forms of hernia, involving at times the entire bowel, and leading to great perplexity in diagnosis and surgical treatment in case of strangulation. This is particularly true of the duodenal fossæ.

Although the duodenal fossæ were described as early as 1776 by Neubauer, their importance was first pointed out by Treitz in 1857 (*Hernia Retroperitonealis*, Prague, 1857), who described their anatomical peculiarities with accuracy, and emphasized the fact that both small and large herniæ occasionally developed within them.

FIG. 1.

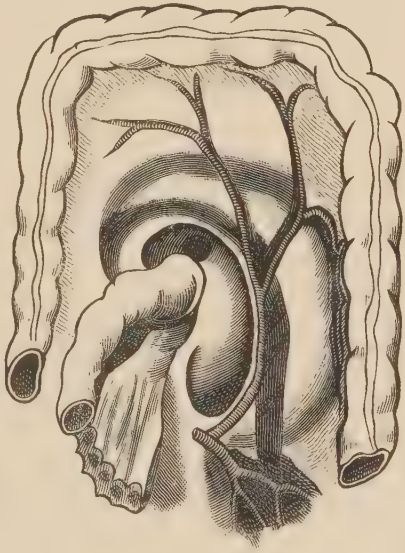


A, superior duodenal fold ; B, inferior duodenal fold ; C, inferior mesenteric vein. (Juvara.)

FIG. 2.

Treitz's case of left duodenal hernia. (Moynihan.)

FIG. 3.



Paraduodenal fossa or fossa of Landzert. (Moynihan.)

The duodenal fossæ lie opposite the third lumbar vertebra, where the duodenum emerges from the transverse mesocolon. They are formed by folds of peritoneum attached to the duodenum. If in the cadaver the abdomen be widely opened by both longitudinal and transverse incisions, and the colon pulled upward so as to put its mesocolon on the stretch, while the mass of small intestine, with its mesentery, be thrown over to the right, one or two more or less well-defined folds of peritoneum may often be seen fastened to the duodenum near to the point where it merges into the jejunum. Rarely are they attached to the jejunum itself. These folds form the borders of corresponding peritoneal fossæ, which were formerly called duodenojejunal fossæ (Treitz); but, seeing that they are more intimately connected with the duodenum than with the jejunum, the term duodenal fossæ is preferable.

To assist in gaining a clear idea of the situation, one can imagine that the lower portion of the duodenum has been pushed, as it were, through the posterior parietal peritoneum at the base of the transverse mesocolon, dragging with it attachments of the peritoneum or mesocolon, or both, which necessarily form folds. If it is the mesocolon, the fold will have its sickle-shaped concavity toward the pelvis, the resulting fossa extending toward the diaphragm; while, if the posterior parietal peritoneum is concerned, the concave border of the fold will be toward the diaphragm, the fossa bulging toward the pelvis. The former condition gives rise to the superior duodenal fold and fossa (Fig. 1, *a*), while the latter causes the inferior duodenal fold and fossa, sometimes designated the "fossa of Treitz" (Fig. 1, *b*).

In addition to these two principal folds, others of minor importance may exist, especially an intermediate one. All of them may be present at once, or any of them may occur singly. They may be so poorly developed as to escape all but the closest observation, or they may be so prominent as to form deep, well-marked pockets.

The inferior mesenteric vein encircles the left border of the duodenal fossæ, generally passing quite close to it (Fig. 1, *c*). The left colic artery is usually found more externally. These vessels form the so-called "arch of Treitz." They are a source of danger

if an attempt is made to incise the neck of the sac when strangulation is present.

It has always been thought that left duodenal hernia—one in which the sac develops beneath the posterior parietal peritoneum principally to the left of the median line (Fig. 2)—almost invariably occurs in connection with the inferior duodenal fossa; but with this Mr. Moynihan does not agree. He believes that another fossa, which occasionally appears somewhat external to this, is responsible. This he designates the "paraduodenal fossa," or "fossa of Landzert." It is formed by a fold of peritoneum (plica venosa), elevated by the inferior mesenteric vessels (Fig. 3). His main argument is based on the fact that the mouth of the hernial sac is always vascular. This argument, however, seems open to question—in the larger herniæ, at least—as it would require but little stretching of the opening to bring the inferior mesenteric vein in such intimate relation with the mouth of the sac that accurate differentiation would be impossible.

Mr. Moynihan, in his excellent monograph,[1] has collected fifty-eight cases of left duodenal hernia, thus showing that although the affection is sufficiently uncommon, it is not so rare as was heretofore supposed. Strangulation, however, seldom occurs, Jonnesco having found mention of but eight cases in the literature of the subject.

Some time ago it was my fortune to meet with a strangulated left duodenal hernia in a strong, well-developed man, aged forty-seven years, an American by birth and a miner by occupation. He had always enjoyed good health, except occasional slight indefinite abdominal pains. Following an attack of diarrhœa lasting three weeks, he suddenly developed, four days before I saw him, a severe ileus, with the usual symptoms of acute intestinal obstruction. An operation was at once performed. The pulse was then 120, and unsatisfactory in quality; the temperature subnormal, and the capillary circulation poor.

On opening the abdomen we were surprised to find the cavity

[1] Retroperitoneal Hernia. London, 1899.

occupied by an immense tympanitic tumor resembling an ovarian cyst, which could be outlined on each side and below by passing the hand between it and the abdominal walls. The small intestine was nowhere to be seen, but the colon could be felt below and to the right side. After some deliberation we opened the tough membranous sac, within which was found the entire small intestine, together with the cæcum and some six or eight inches of the adjacent colon. There was also considerable foul and bloody serous fluid, no trace of which existed outside the sac, showing how completely the inner cavity was separated from the outer.

The cæcum, which was distended with fluid feces to the size of an infant's head, and largely gangrenous, lay in the left upper quadrant of the abdomen, just beneath the spleen, in the vicinity of which the swollen appendix was attached by recent inflammatory adhesions. Several inches of the large intestine near the cæcum were also gangrenous. The cæcum and neighboring colon possessed a very long mesentery, which rendered them freely movable.

In tracing the colon from below upward, it was seen to emerge from the small pelvis upon the left side, as usual, and then pass directly across the lower portion of the abdomen, coiling itself loosely in the right iliac fossa and right lumbar region, outside the sac containing the small intestine. It then entered this sac through an opening on the right side posteriorily, and, passing beneath a portion of the small bowel, ended in the cæcum in the superior lumbar region on the left side. The colon was strangulated at the point where it entered the sac.

In attempting to relieve the condition it was necessary to resect the gangrenous cæcum, together with some six inches of the large intestine and a considerable portion of the small bowel. In doing this the gut was crushed with an angiotribe, the cut ends invaginated, and the opening closed with an over-and-over suture. A side-to-side anastomosis was then made with a Murphy button between the lower end of the ileum and a loop of colon in the right iliac fossa.

The patient's resisting powers were so poor, and the operation was so complicated and extended, that death resulted. No autopsy

was obtained, but the abdomen had been so freely opened that the condition was evident as described.

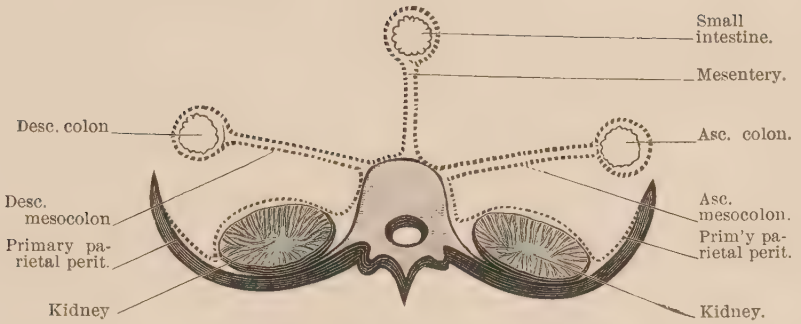
This case seems, in some respects, unique. In no other instance, so far as I am aware, has any portion of the colon been found within the sac of a duodenal hernia; in fact, several writers state specifically that the colon invariably remains outside, as though this were an important characteristic of this form of hernia. This unusual feature is easily accounted for, however, by the mesentery of the cæcum and colon being of abnormal length.

Another anomalous condition is to be noted in the fact that the entire colon lay in folds upon the right side of the abdomen, instead of encircling the hernial sac, as was to be expected. Such a malposition is usually congenital, as I at first imagined it to be in this instance, and arises from rotation of the umbilical loop during fœtal life in a direction contrary to the normal, thus carrying the whole large bowel over to the right side, beneath the mass of small intestine instead of above it. This, however, is probably not the correct explanation in the present case. It is more likely that the cæcum and colon originally possessed an exceedingly long mesentery (Fig. 4), and that adherence of the descending colon in the left lumbar region failed to take place as it normally should in the course of the development of the individual (Fig. 5). The attachment of such a mesentery would be near the centre line of the body, close to, or identical with, that of the mesentery of the lesser bowel. Under these circumstances it can be imagined that the duodenal fossæ might be present to even more than the average extent, because of the looseness of the mesocolon, which normally is so firmly adherent to the posterior parietal peritoneum as to practically form part of it.

Hence, if a duodenal hernia should occur, as it would probably have an exceptionally good opportunity of doing, the sac would have a tendency to develop to the left of the large bowel instead of to the right of it, thus displacing the descending and transverse colon to the right side of the abdomen, providing the hernia was of large enough size.

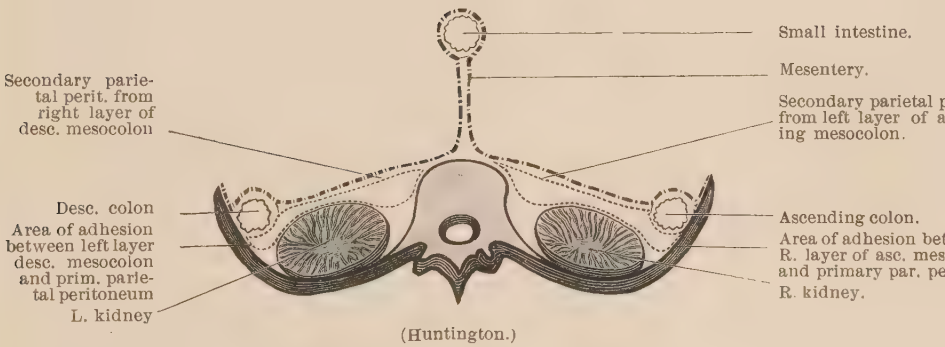
In the formation of a post-peritoneal hernia such as the one under consideration, the duodenum enters the opening first, drag-

FIG. 4.



(Huntington.)

FIG. 5.



(Huntington.)

ging after it the jejunum and then the ileum with their mesentery. The cæcum, being attached to the lower end of the ileum, would enter last. As the mouth of the hernia is situated toward the posterior aspect of the sac, the cæcum would be apt to pass beneath the greater portion, at least, of the small bowel, as was the case in the present instance. Strangulation of the colon would be quite likely to occur owing to stretching of the mesenteric vessels and pressure against the sharp edge of the sac.

The fact that the colon alone was found to enter the sac, without any portion of the small intestine being present in the opening, seems at first a little confusing, unless we remember that the duodenum passes beneath the peritoneum to the duodenal fossa, so that when a hernia is formed the remainder of the bowel is dragged through the opening into the space where the duodenum already lies. Hence only that portion of the bowel which has been pulled in, so to speak, can pass through the hernial opening. This condidition, which is often found, to say the least, would seem to contradict the opinion of Moynihan that duodenal herniæ almost invariably occur to the paraduodenal fossa beneath the plica venosa, as this would necessitate the entrance of the duodenum into the general peritoneal cavity before it could enter the sac (Fig. 3), which would lead to two sections of bowel being found in the opening instead of one.

Since writing the above I have encountered, during an autopsy, a second case of left duodenal hernia. The patient died from gangrene of the small intestine, accompanied by severe hemorrhage arising from thrombosis of the mesenteric and portal veins, which, in its turn, was dependent upon a "hobnail liver." The hernia was apparently in no way concerned with the fatal issue.

The individual was an exceptionally strong, well-developed man, aged forty-seven years, who had always enjoyed good health. He had been subject, however, to indigestion, and occasionally experienced slight pains and uneasiness in the abdomen.

The sac filled the entire left side of the abdominal cavity, and pushed well over to the right of the median line. It contained

all but six inches of the small intestine, the transverse and descending colon being spread out upon its upper and left outer surfaces, leaving the ascending colon and cæcum in their normal positions. The mouth of the sac was round and smooth, and easily admitted three fingers. From it emerged the lower end of the ileum, to join the cæcum in the right iliac fossa. The opening was just to the right of the vertebral column, on a level with the crest of the ilium and toward the dorsal and inferior portion of the sac. Its free ventral border was occupied by the inferior mesenteric vein, while the left colic artery ran much farther to the left along the posterior abdominal wall.

The small intestine, which appeared to be unusually short, was arranged in regular parallel folds, like a Mikulicz drain, running from the left below to the right above. The omentum was short and thick, and pushed up above the sac to the right side. There was no strangulation of bowel or mesentery.

DISCUSSION.

Dr. Joseph C. Bloodgood, of Baltimore.

I do not know whether any of the Fellows have observed this form of hernia to exist as a complication of laparotomy; but I have observed one case in which the diagnosis was confirmed at the operation, and the patient recovered. The operation was for an ordinary left inguinal hernia in a physician who was a great friend of mine, and although there were no complications, I found that as he came out of the anæsthetic he vomited more than is usual. He continued to do so for thirty-six hours, and there was a rather rapid distention of the abdomen, at any rate, more rapid than you usually see without obstruction. Enemata were frequently given, and brought away a large amount of gas. The distention was chiefly down in the upper right abdominal zones. Within thirty-six hours the liver dulness was obliterated. In addition to these symptoms, the leucocyte count rose from 10,000 to 16,000; and although his condition was very good, he persisted in vomiting. The obliteration of the liver dulness and slight leucocytosis made me feel that I was not dealing with the ordinary distention due to the anæsthetic, and for this reason I decided to explore the abdomen above the incision. In passing my hand down behind the hernial wound, no adhesions were found. On lifting up the omentum I noted that the transverse colon was not distended. There was no blood-stained fluid in the abdominal cavity, but there were collapsed loops of the small intestine. In pushing them out of the way I felt something give way, and I drew up into the wound a knuckle of intestine showing evidence of partial strangulation. Then came an enlarged loop of intestine. The intestine was released and the wound closed. The case represents the first one of intestinal obstruction following 800 operations for hernia.

Dr. Ellsworth Eliot, Jr., of New York City.

I have never had an opportunity of observing one of these cases, but I believe attention has been called to the presence of large vessels in the constricting neck, and I would like to inquire of Dr. Freeman whether he divided the constricting neck in order to release the imprisoned intestine. I think, in carrying out this procedure, that it is very desirable to avoid cutting the large arteries, as gangrene would probably follow; while dividing the adjacent inferior mesenteric vein might also lead to serious disturbance of the circulation of the lower large intestine.

Dr. Freeman. The inferior mesenteric vessels were present in the opening of the hernial sac. I could not dilate the opening or divide the vessels with safety. Hence I resected a portion of the large intestine, and pulled the remainder through the opening, afterwards making an anastomosis between the lower end of the ileum within the sac and the ascending colon without. Sometimes one may be compelled to do this instead of attempting to divide the hernial opening.

THYROIDECTOMY AND SYMPATHECTOMY FOR EXOPHTHALMIC GOITRE.

By B. FARQUHAR CURTIS, M.D.,
NEW YORK CITY.

The surgical treatment of exophthalmic goitre has excited much interest of late years because of the failure of medical treatment in many cases, although, if the disease has not progressed too far, and if the circumstances of the patients render it possible to carry out systematic treatment for a sufficiently long time, rest, hygienic measures, and proper medication will generally produce a cure, or, at least, hold the symptoms in check. Surgical treatment is able, however, to cure many cases which have not yielded to medicine. But it has very serious dangers of its own, especially the danger of acute exacerbation of the symptoms, known as thyroidism or thyroid poisoning, which may follow any operation in these patients —whether the operation concerns the thyroid gland or other parts of the body.

The various operative measures which have found favor in exophthalmic goitre are:

1. Thyroidectomy of one-half of the gland. Resection of smaller portions and enucleation of cysts or tumors appear to be much more dangerous in these patients, on account of the greater danger of hemorrhage. (Kocher.)
2. Ligation of arteries.
3. Erythyreopexy.
4. Sympathectomy, or partial or total excision of the cervical ganglia.

To take the minor operations first, erythyreopexy—which has been tried in exophthalmic as well as simple goitre—has not given permanent results, although some of the cases were tempora-

rily improved. The operation has never been a popular one, and the surgeons who once advocated it appear to have lost interest in it. In this operation the gland is exposed by making free incisions through the parts covering it, and, when exposed, is partly raised from its bed and left lying in the open wound, covered only by the dressings.

With ligation of the arteries the writer has no personal experience, as he has done it only in connection with other operations. Kocher has found that ligation alone is seldom sufficient, but recommends it as a preparatory treatment for cases in which the patient's condition is too serious for a thyroidectomy, ligating both superior thyroids, for instance, and, when some improvement has been obtained, proceeding to the graver operation. It is to be noted that ligature of the inferior thyroid vessels is almost as serious an operation as thyroidectomy. He also employs it at the same time as thyroidectomy of one-half of the gland, tying one or more arteries of the remaining half when the latter is very large; or, finally, the arteries of the other half may be ligated later, after removal of one-half of the gland, if improvement is not obtained or if the gland is growing. In Kocher's 59 operations,[1] done for exophthalmic goitre, he performed thyroidectomy of one-half in 14 cases; ligation of arteries in 16 cases; both at once in 19 cases. Thyroidectomy of one-half, part resection of other in 4 cases; thyroidectomy of one-half, part resection and ligature in 3 cases; ligature and partial resection in 1 case; ligature and sympathectomy (partial) in 3 cases.

Thyroidectomy. The majority of Kocher's operations were thyroidectomies. In all he operated upon 59 patients, with a death rate of 6.7 per cent. (4 cases); 76 per cent. were cured, 14 per cent. improved, 3.3 per cent. slightly improved. He acknowledges no failures.

Rehn[2] collected thyroidectomies by 37 operators (Kocher not included) and 114 cases from literature. The mortality of the

[1] Ueber Morbus Basedowi. Mittheilungen aus der Grenzgebiete, 1902, ix. p. 1.

[2] Die chirurgische Behandlung der Morbus Basedowi. Ibid., 1900, p. 165.

first series was 13.5 per cent.; of the second 11.4 per cent. The mortality of 95 severe cases of the picked operators' series was 22 per cent. (21 cases). The cures of these two series were claimed to be 57.6 and 54.8 per cent. respectively, figures practically identical; and 26.5 and 27.9 per cent., respectively, were improved.

The writer's experience with thyroidectomy has consisted of 11 cases, with 3 deaths (all due to acute thyroidism without wound complications), 6 cures, 1 improved, and 1 case could not be followed. The death rate is greater, otherwise the results correspond.

As to the details of the symptoms in improvement and the variations of severity in the symptoms before operation, I must refer you to the histories subjoined. The operations were all performed in the same way. The gland was usually exposed by transverse incision, the superior thyroid vessels tied, the gland retracted inward after ligation of superficial veins, and the inferior thyroid vessels secured, the artery usually being tied near its origin, the isthmus then divided, leaving a generous layer of gland tissue over the neighborhood of the recurrent laryngeal nerve. The isthmus was sometimes crushed and ligated *en masse* with catgut; sometimes divided with the cautery. Each was given a trial, with the idea that it might affect the occurrence of thyroid poisoning, but the latter occurred with both methods. Great gentleness was employed in handling the gland, to avoid the supposed danger of causing vascular or lymphatic absorption of thyroid material. General anæsthesia with ether was employed, because we were afraid of the action of cocaine on the heart and because it was supposed that the strain of an operation under local anæsthesia might be too great for these nervous patients. I shall return later to a consideration of this subject. In these operations the development of the condition known as acute thyroidism is the principal danger I have observed. The operations were not unusually difficult, the tumors were not unusually vascular (with two exceptions), and the anæsthesia was fairly well borne, although some of the patients became somewhat cyanotic. No accidents followed from this cause.

Sympathectomy. Suggested by Edwards and popularized by Jaboulay[1] and Jonnesco,[2] operations upon the ganglia of the neck have given excellent results in the treatment of this disease. Jaboulay, who is the most ardent advocate of the partial operations, removes the superior ganglion only, but his results are not very satisfactory. In 17 cases he had two deaths—from erysipelas and pulmonary congestion—not due to any peculiarity in the operation itself. He followed five cases for a year or more, with the result of two complete cures, two "cures" in which the patients had a current enlargement of the thyroid when last seen, and one case with some heart symptoms, which he terms "cardiopathy." Balacescu has collected 27 cases of partial operations, including Jaboulay's, and figures out 33.3 per cent. cures, 40.7 per cent. improved, 7.4 per cent. not improved, and 18.6 per cent. deaths.

The complete bilateral removal of all of the sympathetic ganglia of the neck has been most often employed by Jonnesco, who first advocated it as necessary. He has operated 13 times; and if we add to these cases 4 cases by French surgeons (collected by Balacescu), we obtain 17 cases, of which it is said that 10 were cured (58.9 per cent.), 5 improved (29.4 per cent.), 2 not improved (11.7 per cent.). There were no deaths, but I think Case XVII, with death from chloroform, should have been included in these results.

Alarmed at the frequency of acute thyroidism after thyroidectomy, and attracted by the immediate good results claimed for sympathectomy, the writer began to do the operation two years ago, and has performed it in 7 cases; but the results have not been much better than those of thyroidectomy, for there have been two deaths from acute thyroidism and one death probably due to the anæsthetic. All the operations were done with ether anæsthesia, but it was made as light as possible, and in the case in which it was supposed that death was due to the anæsthetic the only symptoms were a gradually increasing cyanosis and pallor, and I think the death was caused by an accumulation of mucus in the air-passages,

[1] Chirurgie du grand sympathique et du corps thyroïde. Lyons, 1900.

[2] Archiv für klin. Chirurgie, 1902, lxvii. 39. Balacescu, "Die totale und bilateral Resection des Sympatheticus cervicalis beim Morbus Basedowi."

taking place so slowly that it was not observed, as there was very little mucus in the pharynx or larynx.

The operations were performed on both sides at one sitting, except in one case. In the first case (XII.) the incision was made posterior to the sternal portion of the sternocleidomastoid; in all the rest it was made along the anterior or internal border of that muscle. The anterior incision has the advantage of allowing access to the superior ganglion without extending quite so high, thus leaving a scar which is more easily concealed by the clothing. The usual technique of the operation was exposure of the sheath of the great vessels; their retraction to the inner side, accompanied by displacement of the goitre; exposure of the sympathetic trunk in the middle of the wound, tracing it upward to the superior ganglion. The latter was then isolated bluntly with forcible retraction of the upper angle of the wound and a good light, an artery clamp placed upon the nerve just at the upper limit of the ganglion, and the ganglion twisted out. The nerve was then followed downward, and the second and third ganglia isolated and removed. The second ganglion is sometimes in close relation to the inferior thyroid artery, which may have to be ligated in order to remove it intact, the strands of the nerve sometimes separating and lying both in front and behind the artery. The second ganglion also is often small or fused with the third. The third cervical ganglion is often fused with the first dorsal ganglion, and will have to be separated with scissors or knife after blunt isolation. I look upon this part of the operation as the most difficult, because of the considerable depth of the ganglion and the proximity of important structures. The recognition of the nerve also presents serious difficulties in some cases. It is very variable in size and appearance. In one case the nerve was represented by a number of separate fine filaments running parallel to each other, with considerable intervals between them, instead of a well-developed trunk. In any case it should be a cardinal rule not to inflict any damage upon a structure supposed to be the nerve until it has been proved to be the sympathetic by tracing it to either the upper or lower ganglion. The wounds were closed without drainage.

It is rather early to judge of final results, but so far the record is 3 cases cured, 1 improved, none unimproved, 3 cases died.

The main object of this paper is to present the danger of acute thyroidism or thyroid poisoning in surgical operations upon persons with exophthalmic goitre, and to discuss its possible causes and means of prevention. The symptoms of this condition are the following: The patient may have been put to bed in good condition after operation, having required no stimulant and apparently ready for a good convalescence. The temperature will, however, soon rise to 102° or 103° F. Usually it will reach 103° or 104° F. in twenty-four hours, and then continue to 106° or 107° F. With the rising temperature the pulse will run up to 130, 150, even 200. The face will be flushed (in thyroidectomy as well as in sympathectomy), the breathing hurried and superficial. The patient will be nervous, twitching, tremulous, talking a great deal. Anxiety, however, I have not usually seen, the mind generally remaining clear and calm enough to the end. In some cases coma has been present, but this is unusual. Death may be sudden at the last; in one case the patient had apparently been sleeping quietly, when he awoke with urgent dyspnœa and died in a few minutes of sudden arrest of the heart. In other cases death comes from gradual exhaustion or from œdema of the lungs. Morphine will quiet the restlessness, but we can find no means to control the heart. Strychnine, digitalis, digitaline, saline intravenous infusion, and even aconite have been tried in vain. They are useless, or even make the heart worse. One case only survived these symptoms for forty-eight hours. In one case of sympathectomy and one case of thyroidectomy only did serious symptoms like these terminate in recovery. The remedies used were those mentioned —morphine, bromides, aconite, and an ice-bag to the heart region.

The temperature after operation in nearly all of these cases of exophthalmic goitre was very high, even when they recovered with primary union of the wounds and without any other marked symptoms of the thyroid state. In several cases examined there was no leucocytosis with this rise of temperature. The study of this fever is interesting.

Thus, of the cases which recovered, the highest temperature attained within twenty-four hours after the operation was: Thyroidectomy—Case I., 102.6° F.; Case III., 103.2° F.; Case IX., 103.4° F. Sympathectomy—Case XIV., 101° F.; Case XV., first operation 101.6° F., second 102.6° F.; Case XVII., 102.6° F.

Of the fatal cases the highest temperature in the first twenty-four hours was: Thyroidectomy—Case II., 104° F.; Case VIII., 102° F.; Case XI., 101.6° F. Sympathectomy—Case XVI., 103° F.; Case XVIII., 106° F. The temperature in all reached even a higher point before death.

A careful study of each case at the time and a thoughtful review of the facts since has failed to throw much light upon the causes of the catastrophe or to disclose any signs which might serve to warn one that operation would be dangerous in any case. The condition of the eyes, the rapidity and character of the pulse, and the nervousness have all been carefully considered, and yet no essential difference could be found between the cases which recovered and those which did not. The only possible sign of warning which I have been able to discover lies in the condition of the kidneys.

In all of the 5 fatal cases a trace of albumin—or even a considerable quantity—with granular casts, was found in the urine after operation; but in only two of them was albumin found in the examinations before operation. Of the cases which recovered two—Cases I. and III.—had the same changes in the urine after operation. Two others which recovered—Cases IX. and XV.—had a trace of albumin, with hyaline casts. All four of these cases had a marked reaction in temperature, and other symptoms, also, after the operation. The fact that the casts were granular in the worst cases proves that they were not due to the temporary irritation of the kidney; but the absence of albuminuria before the operation would indicate that the kidney was not very seriously diseased. The most that can be claimed for this sign is that the presence of even a trace of albumin in the urine would be an indication of special danger of acute thyroidism in case an operation was undertaken. Yet in at least one such instance (Case XIV.) recovery followed, although after an alarming reaction.

Kocher believes that any septic infection of the wound increases the danger of this condition. As I had no disturbances of wound healing, further than the formation of a hæmatoma, I am unable to testify upon this point.

Three theories have been advanced to account for this thyroid poisoning or acute thyroidism: (1) nervous influences, such as shock; (2) absorption of toxic thyroid material; and (3) absorption of toxic blood. These marked and definite symptoms, forming such a typical picture of tachycardia, violent febrile movement, and peculiar nervous unrest and excitement, appear to the writer best ascribed to a central functional disturbance like that commonly known as shock. Some years ago the writer pointed out that a sharp rise in temperature is, apparently, a common symptom of severe shock after our prolonged modern operations. In favor of the nervous origin of these symptoms is the fact that such attacks are occasionally seen in patients with exophthalmic goitre under the influence of some great nervous excitement. One of my cases had been prepared for operation in the usual way—washing of the neck the previous evening, abstention from food, etc.; but two hours before the time set for the operation (2 P.M.) she had a sudden rise of temperature to 101° F., with flushed face and increased nervousness. The operation was postponed. The leucocytes at 6 P.M. were found to be 9000. During the night the temperature fell to normal, but rose to over 100° F. in the afternoon for two days afterward. More than one of the cases showed a temperature of 100° F. or even 101° F. on admission to the hospital, subsiding more or less rapidly under treatment. The frequency of thyroidism after sympathectomy and in operations not involving the thyroid gland is also in favor of their nervous origin.

The most popular theory has been the supposed absorption of the juices or secretion of the thyroid gland. Some (Rehn) have stated that after thyroidectomy for ordinary goitre a rise of temperature was the rule. In the writer's experience, however, this is not more common than in other operations, and he is glad to find the extensive experience of Kocher correponds with his.

To avoid the absorption of these fluids some have warned us

not to be too energetic in our efforts of sterilizing the neck in these cases. But the rise of temperature occurs too late (operation usually fifteen to eighteen hours after sterilization) to be due to this supposed rough handling of the neck. Others advise very gentle manipulation of the gland during removal, and this precaution I have always taken. I have also tried various methods of dividing the isthmus, with the same object of avoiding the escape of fluids into the wound or leaving large portions of the gland tissue to be absorbed, but in vain; the symptoms developed in spite of every precaution. They seem also to be as common after sympathectomy as after thyroidectomy.

Kocher has advanced the theory that the symptoms are due to autointoxication of the patient by absorption of blood effused in the wound cavity, as some have claimed that there are toxic substances in the blood of these patients. But it has not been proved that blood effused into the wound and reabsorbed would be more poisonous than the same blood while still circulating in the vessels, and this theory does not explain at all the similar attacks without operation. It has also been stated that the urine of these patients is toxic. Dr. F. C. Wood, the pathologist of St. Luke's Hospital, kindly made some experiments with the urine obtained from Case XVIII. after operation, injecting it into animals; but his results were negative.

In Kocher's and Jonnesco's published cases there appear to be very few instances of fatal thyroidism; none at all in Jonnesco's. I have carefully searched these reports to discover why they did not meet with this serious complication. A study of Kocher's cases reveals that in two of his four fatal cases there was a very marked reaction of Graves' symptoms after the operation, although in one of these the death appears to have been due to cerebral embolism.

In 29 operations limited to ligation of the thyroid arteries, thyroidism followed in 7 cases, being slight in 3, fatal in 1 case. In 38 partial thyroidectomies, thyroidism followed in 9 cases, being slight in 4, fatal in 1 case—death by embolism, just mentioned. In either form of operation, then, about one-quarter of the cases suffered from these symptoms. I have sought through the histories

for evidence in regard to the condition of the kidneys in those cases with thyroidism, and find a trace of albumin in the urine in only one case before operation. (There is no note as to the presence or absence of albumin after operation in any case.) In 3 of the cases the condition of the urine is not given, including the two fatal cases. It is worthy of note that in the entire series of 59 cases albuminuria was noted only once.

In regard to the question of anæsthesia, a general anæsthetic seems to have been employed by Kocher only three times, and every time marked thyroidism followed—two being the fatal cases already mentioned. Febrile reactions followed operation in 32 cases, the temperature running from 37.8° to 40.8° C., but, as a rule, lower than those I have observed. In 9 cases the fever was due to infection, and in 1 case to pneumonia; 1 case with a temperature of 40.4° C. recovered with primary union.

The reports of Jonnesco's cases are not full enough to be very useful in this study; but in 2 or 3 cases symptoms of high fever, etc.—apparently acute thyroidism—followed sympathectomy, but ended in recovery. Of Jonnesco's 14 personal cases of bilateral sympathectomy, the operation was done on both sides in one sitting in 4 cases, and a moderate reaction followed in two of these, the other 10 cases having the nerve removed upon only one side at a time, only one of these cases showing a reaction.

The principal differences, then, that I find between the operations of these surgeons and those of the writer are in the anæsthesia and in the less frequency of the bilateral sympathectomy in one sitting. Kocher employed cocaine locally, and in only certain bad cases resorted to general narcosis. It is interesting to note that he met with the severest reactions in these cases. In Jonnesco's report the anæsthetic is only mentioned once, when it is stated that chloroform was employed. Apparently general anæsthesia—not local—was used by him.

Does Kocher's use of cocaine anæsthesia explain his better results? In the absence of evidence on this point we must neglect Jonnesco's cases. It has been stated by some that cocaine is especially dangerous as an anæsthetic in cases of exophthalmic

goitre, but Kocher's large experience proves that this idea is erroneous. As to chloroform, there is, at least, one death during sympathectomy (Faure, Balacescu) to be charged to it.

On the theory of poisoning by thyroid substances or toxic blood it seems unlikely that there would be any difference between local and general anæsthesia, unless we add the fact noted above, that damaged kidneys increase the liability to thyroidismus; and then we might frame the hypothesis that the ether impaired the function of these organs so much as to prevent them from eliminating these toxic substances. On the theory that the symptoms are due to shock, this difference might be as easily explained, for it must be admitted that in such operations as thyroidectomy general anæsthesia tends to increase the shock.

The writer has employed local cocaine anæsthesia in thyroidectomies for ordinary goitre with excellent results, but hitherto has hesitated to use it in operations upon patients with exophthalmic goitre, because he feared the effect upon the heart; but hereafter he intends to make a trial of it in these cases also.

Recently he has used the suggestion of Huntington, of San Francisco (*Annals of Surgery*, March, 1903), to anæsthetize the middle branch of the superficial cervical nerve with cocaine, and so gain sufficient anæsthesia to permit of thyroidectomy with only three or four drops of a 2 per cent. solution of cocaine. The results have been good, and a similar method might prove useful for sympathectomy. If this can be done we shall be able to gain anæsthesia with such a small amount of cocaine that there will be no danger from that source.

The second point noted above was the fact that in 10 out of his 14 cases Jonnesco divided the operation of sympathectomy into two stages, and it now seems to the writer that Jonnesco's freedom from the complication of thyroidism may have been due to this caution. In defence of his own choice of doing both sides at once, the writer would state that he formerly held the view very generally advocated up to the present, that the symptoms were due to toxæmia, and, therefore, did not realize the importance of minimizing shock. In all but one of his cases the patient appeared to be in

as good condition at the time of beginning removal of the second nerve as at any time. The pulse and general condition usually improved when one nerve had been excised. Finally, he found it of great assistance in the dissection to make both incisions immediately at the beginning of the operation, dividing the deep fascia, because the goitre was thus rendered much more movable and the patient's breathing was improved. The patients, moreover, generally rebelled at the idea of being submitted to operation twice. In the light of the experience and study just completed, the writer believes that, in spite of these reasons, for the present it will be wiser to divide the operation into two parts.

I have also thoroughly considered differences in technique which might affect the results obtained in Europe and here—differences which might increase shock (by unduly prolonging the operation) or tend to the formation of hæmatoma in the wound. In this connection it can be pleaded that methods which did not usually have this effect when employed by the writer in other operations should have been satisfactory also in these. Further, the absence of disturbances in wound healing is evidence that the technique was not bad. The majority of the operations were not unduly prolonged, although a few were tedious, and in most of them there were no marked symptoms of shock at the conclusion of the operation.

Summary. *Results:* Exophthalmic goitre can be cured both by thyroidectomy and by sympathectomy. A perfect result can be expected in about 60 per cent. of the cases of thyroidectomy. An immediately good result appears to be the rule in sympathectomy. Sufficient time has not elapsed to judge of the permanence of the cure, but the immediate results of sympathectomy are far superior to those of thyroidectomy.

Mortality. The relative mortality of the two would also seem to favor sympathectomy (Kocher 4 deaths in 59 cases of thyroidectomy or ligation only; Jonnesco none in 14 cases of bilateral sympathectomy), although in my own cases the result is the opposite. There is serious danger of fatal acute thyroidism after both operations.

Technique. It appears to the writer wise to use local cocaine anæsthesia for thyroidectomy, and to give it a trial also in sympathectomy. Sympathectomy should be performed upon only one side at a time, with an interval sufficiently long to permit the patient to recover from the effects of the first operation.

Case I.—Louise E., aged twenty-four years; single; New York; saleswoman; admitted to St. Luke's Hospital November 8, 1893. Referred by Dr. J. A. Booth.[1]

Family history negative.

Personal History. Menstruation began at fourteen years—regular, normal. Seven years ago had a high fever, lasting three weeks (supposed malarial). Three years ago noticed swelling in neck, and her eyes became prominent. Goitre increased slowly until ten months ago; then neck measured thirteen and one-half inches. Was treated with electricity, reducing size of goitre, but not improving eyes. A little over one year ago noticed palpitation and rapid heart action, which is not so bad now as at first. At about the same time menstruation ceased for five months.

Examination. Patient is very nervous, marked exophthalmus, thyroid gland much enlarged, chiefly on right side, but involving both lobes. Marked pulsation in carotids. The thyroid mass is not cystic—it is firm. The right border overlaps right sternomastoid; the left does not reach the left sternomastoid. Neck measures twelve inches at most prominent part of mass. Heart action tumultuous, rapid pulse (142), apex-beat normal, no murmurs; lungs negative, respiration rapid (twenty-four to the minute). Temperature, 100° F.; urine acid, 1023, faint trace of albumin, no sugar, leucocytes, mucus.

Treatment. Tr. digitalis, ♏viij; sod. brom., pot. brom., āā gr. v, t. i. d.

November 11, 1893. Ether narcosis. Angular incision; median below, diverging to right above, over thyroid. Vessels of right side dissected and ligated. Gland drawn out. Accessory lobe found at lower angle and removed. Isthmus ligated and right

[1] Dr. Booth has published some of these cases in the Journal of Nervous and Mental Disease, September, 1902.

half of thyroid removed. Wound dry. Sutured with catgut. No drain. Sterilized gauze dressing and starch bandage. Pulse at end of operation 180, irregular and intermittent. Restless; quieted with Magendie's solution.

Temperature before operation was for two days between 99.4° and 100° F. (mouth); four hours after operation 102.6° (rectal), falling steadily to 99.6° twelve hours later; for three days it ran from 99.4° to 101.4° F., with regular afternoon rise. Thence onward from 98° to 100° F., becoming normal.

Pulse. Before operation 110 to 142; four hours after operation 172. With low temperature next morning it was only 108, and then for three days it ran from 122 to 140, except on two occasions, 170 and 160; followed temperature, and settled to a rate of between 90 and 120 on discharge. Respiration remained about the same (20 to 24), except with the high temperature, when it reached 28 to 30 per minute.

No digitalis given after operation (intermittent pulse), but bromides continued.

Urine contained 8 per cent. albumin, with hyaline casts and epithelium the day after operation, but the following day there was only 1 per cent. of albumin, and none afterward.

Except for her restlessness and some nausea and pain in the throat, she seemed well. Primary union followed. She was allowed up November 22d, and walked next day without any increase in the tachycardia. The eyes showed beginning recession. Discharged November 27th.

1902, eight and one-half years after operation: "For the past six years has been employed in one of the large department stores, being on her feet most of the time from 8 o'clock in the morning until 6 at night, not missing a day from her work; and during this period she has not been disturbed by any of her former symptoms. . . . The prominence of the eyes is still present, but to a much less degree. . . . The tremor has disappeared. . . . She has no palpitation. . . . The pulse is 80. . . . I think we are justified in believing her cured." (Booth, *loc. cit.*)

CASE II.—Nellie D., aged forty-two years; single; New York; seamstress; admitted to St. Luke's Hospital September 26, 1894. Referred by Dr. J. A. Booth.

Family history negative.

Personal History. "Nervous prostration" when young, severe typhoid when about twenty-five years of age, followed by dropsy. Two years ago began to lose flesh and strength, suffered from thirst and passed large amounts of urine. During past year has been treated for diabetes, and has regained flesh and strength. Has had severe neuralgia, face and chest, during last fifteen years. Just before this began had fever, cough, and was supposed to have phthisis.

Present History. Thirteen years ago first noticed swelling of throat, which has increased gradually. Only lately has she suffered from palpitation and dyspnœa on exertion. For two years has noticed increasing prominence of the eyes and lacrymation. Some dysphagia from pressure of the thyroid tumor. Has always been nervous, much more so of late. Appetite good. Bowels regular.

Examination. Occupying region of the thyroid gland is a three-lobed tumor, the central lobe as large as a small hen's egg, the left lobe the same size, and the right lobe three times as large, reaching nearly to the angle of the jaw, and beyond the line of the sternomastoid muscle. The tumor is moderately soft, does not fluctuate or pulsate, follows motions of larynx on swallowing, is attached to the trachea, and is without adhesions elsewhere. The eyes are very markedly protruding. The right submaxillary gland is enlarged. The heart apex-beat is in fifth space, inside of the nipple line. The first sound is accentuated at the apex. The pulse is rapid (120), but regular. A systolic murmur can be heard over the enlarged thyroid. Lungs normal, respiration twenty-four per minute. Fine tremor present in the hands.

October 2d. Operation. Ether narcosis. Incision angular, over right half of thyroid gland. Vessels ligated. Right half of thyroid removed. Wound sutured.

3d, 2 A.M. Very restless. Pulse 142, irregular, fair force. Brom. sod, 6 A.M.; pulse 160, very weak. Strychnine, gr. $\frac{1}{60}$,

hypod., every hour until 9 A.M., then whiskey by mouth every hour. 10.50 A.M., tr. strophanthus ♏v; hypod. 11 A.M., aconitine, gr. $\frac{1}{240}$. Urine acid, 1025, trace of albumin, no sugar. Hyaline and granular casts; epithelium. 1.15 P.M., morphine (Magendie, ♏vij), with atropine hypod. 2 P.M., profuse perspiration. 4 P.M., face slightly cyanosed. 5 P.M., stopped whiskey. Gave tr. strophanthus, ♏v, hypod., every four hours.

4th. 12.30 A.M., Magendie and atropine. 6.15 A.M., unable to speak. Pulse 174, weak, irregular. Whiskey, ℥ij, every half-hour. 8 A.M., unconscious and still very restless. 12.30 P.M., pulse weaker, very irregular. 3 P.M., unable to swallow. 4.30 P.M., dressing removed. No sign of infection. Reapplied dressing. 4.50 P.M., nutrient enema with whiskey. 5.10 P.M., wet cups to chest. Urine scanty, acid, $\frac{1}{2}$ per cent. albumin, few casts. 5.45 P.M., hot-pack for three-quarters of an hour. 6.30 P.M., strych. sulph., gr. $\frac{1}{40}$, given hypod., without effect. 6.45, patient dead. Temperature after death reached 109.4° F.

Case III.—Susan H., aged forty-three years; married; New York; housewife; admitted to St. Luke's Hospital September 10, 1894.

Family history negative.

Personal History. Pneumonia twenty years ago. Menstruation regular until goitre appeared, and since then during four years she did not menstruate during July to October in each year. Three children, last born five years ago. Perineorrhaphy performed four years ago.

Present History. Twenty years ago she noticed swelling in her neck, choking sensation, and dysphagia. Eyes have always been prominent, but grew worse since goitre began. Severe palpitation of heart, dyspnœa on exertion, nervousness, all followed appearance of goitre. In last six months has lost flesh and strength. Local applications of iodine to goitre did not affect it. Appetite good. Bowels regular.

Examination. A U-shaped tumor occupies region of thyroid gland, left lobe extending up to the level of the thyroid cartilage, right lobe being more prominent and reaching hyoid bone. Lower

border descends a little below the sternum. Tumor is firm, does not fluctuate or pulsate, and is attached to trachea. Dilated veins are seen, and some superficial arteries can be felt.

Heart apex in fifth space outside of nipple line, action rapid, or very irregular, soft systolic murmur at apex. Lungs negative. Eyes very prominent, upper lids move with bulbs. Marked throbbing of carotid. Urine acid, specific gravity 1011, no albumin or sugar.

October 1st. Pulse 92 to 100. Temperature 97.4° to 98.6° F.

2d. Ether narcosis. Oblique incision along right sternomastoid. Ligation of vessels. Excision, right half of thyroid gland. Suture.

3d. Urine acid, faint trace of albumin, no sugar, hyaline or granular casts. Patient very hoarse after operation. 8 A.M., pulse irregular, 120, rather tense. Extract digitalis, fluid, ηij, every four hours.

4th. Stopped digitalis. Pulse still irregular and intermittent. Urine 1020, acid, faint trace of albumin, hyaline casts.

6th. Hoarseness increased; urine same. Wound dressed and sutures removed. Primary union beginning. Pulse better.

13th. Laryngoscopic examination shows right vocal cord stationary in phonation.

15th. Hoarseness less. Primary union. Discharged cured.

September, 1899 (five years after operation). Has been at hard work, and feels well. Pulse 100. Nervousness almost gone. Eyes still prominent, but much improved.

CASE IV.—Amelia B., aged twenty-one years; single; German; admitted to St. Luke's Hospital November 28, 1895; domestic.

Family history. Mother died of phthisis.

Previous History. Diphtheria when a child. Menstruation began at eighteen, regular, four-weekly type, lasts two or three days. Always healthy.

Present History. Four months ago she felt movable painful swelling, size of cherry, on left side of throat, causing pain in swallowing and talking. About a month later it grew to size of a pigeon's egg, and could be seen, and has kept on growing since.

General health good. No dyspnœa. No noticeable change in eyes. Works as usual. Appetite good. Bowels regular.

Examination. Patient well nourished, good color. Heart apex, fifth space inside of nipple line. Sounds muffled. Action rapid but regular. Inguinal glands palpable. Left lateral lobe thyroid enlarged to size of duck's egg, smooth, elastic, non-pulsating, but lifted by great vessels. Slight enlargement right lobe. No exophthalmus. Pulse 80, respiration 24, temperature 99° F. Urine acid, 1026, no albumin or sugar. Microscopically, epithelial cells.

November 29th. Operation. Ether narcosis. Transverse incision. Left half thyroid gland removed, with small accessory lobe below it. Isthmus ligated with catgut and cut across. No drainage. Wound sutured. Recovered without nausea.

30th. A.M., temperature 98.4° to 99° F., pulse 60 to 92; P.M., temperature 101° to 99.6° F., pulse 100 to 90. Urine acid, 1027, trace of albumin. Comfortable, except occasional pain in wound.

December 1st. A.M., temperature 100.4° to 101° F., pulse 96 to 104; P.M., temperature 101.5° to 100.8° F., pulse 116 to 92. Menstruation sets in.

2d. A.M., temperature 100.4° to 100° F., pulse 86 to 100; P.M., temperature 100.4° to 99.6° F., pulse 100 to 88.

3d. Dressing removed. No infection. Collodion applied. Allowed up.

5th and thereafter, normal temperature, pulse 100 to 88.

10th. Incised a small subcutaneous hæmatoma under scar; bloody serum.

12th. Wound healed. Discharged.

Pathological Examination. Gland finely cystic, alveoli filled with material staining in eosin, lined with cubical cells, no papillary formation, no round-cell infiltration.

Patient was seen about six months after the operation. "She was perfectly well, the pulse being 74. No nervousness or insomnia." (Booth.)

CASE V.—Nellie C., aged seventeen years; single; New York; admitted to St. Luke's Hospital December 16, 1895. Referred by Dr. J. A. Booth.

Family history negative.

Personal History. Scarlatina and measles in childhood. When six years old badly frightened by attempt made by her sister to throw her from a window, and "brain fever" followed, lasting two months. Always hyperidrosis of hands and feet. Menstruation normal. When twelve noticed swelling of upper eyelids. Eyesight good. Some nervousness and palpitation, coming on without exertion.

Present History. Two or three weeks ago was told she had Graves' disease. Since then has had feeling of pressure on throat and suffocation. Dizziness on standing. Appetite good. Bowels regular.

Examination. Well nourished. Good color. Considerable exophthalmus both sides. Marked œdema both upper lids, especially left. Eyelids follow globes. Heart apex, fifth space inside of nipple line. Action a little rapid (90 to 100), forcible. No murmurs.

Thyroid gland enlarged, slightly more on the left. Normal consistency. Urine acid, 1015, faint trace of albumin, no sugar. Microscopic examination negative.

December 17th. Ether narcosis. Incision three to four inches long, transverse. Right thyroid lobe removed. Isthmus ligated with catgut. Sutured without drainage. 8 P.M., temperature 99° F.; 12 A.M., temperature 100.6° F., pulse 94 to 104.

18th. A.M., temperature 101.2° to 101.6° F., pulse 108 to 124; P.M., temperature 101.4° to 101° F., pulse 120 to 108. Comfortable at night with small dose of morphine. Allowed fluids. Urine acid, 1032, trace albumin, no sugar, urates.

19th. A.M., temperature 100.4° to 100.6° F., pulse 82 to 92; P.M., temperature 100.8° to 100.2° F., pulse 112 to 88.

20th. A.M., temperature 100° F.; P.M., 98.4° F., and normal thereafter. Pulse 100 to 84.

24th. Primary union. Discharged.

"It is now seven years since the operation. . . . There has been a complete disappearance of all nervousness; the throbbing and palpitation have ceased, and, with two exceptions, the

pulse has not been above 90. . . . No exophthalmus. . . . The peculiar œdematous swelling of the eyelids still persists.'' (Booth.)

Case VI. Addie T., aged thirty-five years; married; United States; admitted to New York Infirmary for Women and Children, January 10, 1896.

Family History. Father was killed, mother died of pneumonia, one sister died of exophthalmic goitre, and another sister also has the disease.

Personal History. Always well as a child. Scarlet fever when eight years old. Was kept indoors as a girl. Menstruation began at thirteen years—natural. Married at twenty-seven years of age. Has had two children, last ten years ago. Immediately after birth of last child noticed swelling in neck, which grew rapidly for two weeks, and since then remained stationary. Of late years has had rheumatism and indigestion.

Present History. Since first noticed, the swelling in the neck throbs, but gives no pain except some ''dragging'' in swallowing. Her heart throbs with every exertion. Frequent micturition, with some local irritation.

Examination. Large goitre, especially on left side—firm, pulsating, size of a large goose egg. No exophthalmus, but eyelids do not follow eyes downward. Decided tremor of fingers. Pulse regular, 110 to 130. No cardiac murmur.

January 11th. Operation. Ether anæsthesia. A longitudinal incision, three inches long, was made over the enlarged left lobe of the thyroid gland, and another extending from this transversely toward the median line. The vessels were ligated, and found rather large and numerous. The left half of the thyroid gland was removed. Sutured by subepidermal continuous stitch of fine catgut. No drainage. Pulse fell to 90 during operation. Recovered from anæsthetic with nausea. 8 P.M., temperature 98.2° F., pulse 94, respiration 22.

12th. A.M., temperature 98.8° F., pulse 84, respiration 24; P.M., temperature 101.4° F., pulse 120, respiration 24.

13*th*. Slept poorly. Complains of pain in heart. Temperature 100.2° to 101.2° F., pulse 100 to 104 (regular and strong).

14*th*. Wound dressed. No infection. Complains of hot and cold "flashes" and of throbbing all over.

15*th*. Highest temperature 100.8° F., pulse 112.

16*th*. 5 P.M., temperature 100.6° F., pulse 92 to 112.

17*th*. Sat up six hours. Feels well. Pulse 92 to 108, temperature 100° F. (highest).

18*th* and thereafter temperature normal.

20*th*. Some bloody serum escaped from wound yesterday and to-day. No pus.

22*d*. Wound healed. Pulse 72 to 84.

23*d*. Pulse 80 to 82.

24*th*. Pulse 80 to 96.

25*th*. Pulse 72. Patient is better every way; feels much less nervous. Discharged.

Patient examined in October, 1897, and again about two years after the operation. "All nervous symptoms had disappeared, there had been no tachycardia, and the pulse was 84." (Booth.)

CASE VII.—Rose W., colored, aged twenty-seven years; single; domestic; United States; admitted to Post-Graduate Hospital October 11, 1897.

Was in this hospital last summer for six weeks, and was improved, but has grown worse since. Has tachycardia on exertion or excitement, not when at rest. Slight nervousness. Thyroid gland enlarged. Heart action regular and rapid. Loud bruit and thrill heard and felt in vessels of the neck. No murmur with heart sounds. Complains of "a lump" in the epigastrium. No tumor found there. Urine, specific gravity 1015, acid, no albumin or sugar. Temperature 98° to 99.6° F., pulse 90 to 128 during October 11th and 12th.

October 13*th*. Before operation, temperature 98.6° F., pulse 112. 2.15 P.M., operation, ether anæsthesia. Transverse incision. Superior and inferior thyroid vessels of right side and superior thyroid vessels of left side ligated. Right lobe and upper half of left lobe of gland removed, the gland tissue being divided

by the thermocautery knife. 3.50 P.M., returned to ward. Pulse 120, regular and strong. No nausea. 12 P.M., temperature 101° F., pulse, 128; beginning to be restless.

14*th*. A.M., temperature 100.6° F., pulse 132; P.M., temperature 101° F., pulse 138; urine: specific gravity 1020, acid, no albumin or sugar.

15*th*. Slept well. A.M., temperature 99.2° F., pulse 100; P.M., temperature 100° F., pulse 108; tinct. digitalis is given, ɱv, every four hours.

16*th*. A.M., temperature 99.2° F., pulse 112; P.M., temperature 100° F., pulse 98.

19*th*. There is a little hoarseness, but examination of larynx shows no paralysis of vocal cords.

21*st*. Discharged. Wound healed; condition improved. Patient has not been seen since.

CASE VIII.—Mary E. F., aged thirty-four years; single; English; sick nurse; admitted to St. Luke's Medical Ward August 13, 1896. Transferred to Surgical Ward May 14, 1897. Referred by D. J. Mabbott.

Family history negative.

Personal History. Scarlatina as child. Diphtheria nine years ago; typhoid fever four and one-half years ago. Always delicate. Menstruation began at fifteen years; irregular, two weeks' or six months' intervals, with pain; scanty.

Present trouble began about eight months ago, while attending patient with severe exophthalmic goitre. Noticed she was getting very nervous, easily startled. Palpitation; eyes gradually became prominent, with profuse cold perspirations and great tremor of hands. Lost flesh and strength. Passes very restless, wakeful nights. Has headache and gastric distress. No increase observed in size of neck.

Examination. Eyes very prominent; upper lid does not follow bulb; patient has to scowl in order to completely close lids. Heart apex just inside nipple in sixth space. Action regular, rapid, forcible. Systolic murmur over apex transmitted into axilla, but loudest over base, especially at junction of sternum and left second

space. Heard in right subclavicular fossa. Lungs normal. Urine: specific gravity, 1014, acid, negative. No enlargement of thyroid.

October 24th. Has improved under sodium glycerophosphate and belladonna. Begin thymus extract, gr. v, t. i. d.

November 14, 1896. Examined by Dr. Kinnicutt. Moderate enlargement of the thyroid, more on the right side; neck measures eleven and seven-eighths inches at greatest fulness. Pulse 131 (rather worse than usual). Extremely nervous. Fine tremor of upper extremities and lower also. Heart apex, fifth space within nipple line. Systolic murmur, apex and base. Marked pulsation of carotids, which is communicated to thyroid. Exophthalmus of high grade in both eyes. Stellwag's and Graefe's signs exceptionally marked.

December 1st. Increase thymus to gr. lx, daily.

January 1, 1897. Patient thinks herself better, but there is no improvement. Neck measures twelve and one-quarter inches.

February 5th. Stop thymus.

22d. Galvanism to both sympathetics.

March 22d. Improved. Neck measures twelve inches.

May 13th. "Patient's condition has not changed in several months." Transferred to surgical service.

14th. Urine acid, specific gravity 1015, trace albumin, no sugar; few blood cells. Ether narcosis 11 A.M. Transverse incision over thyroid. Right superior thyroid vessels ligated; middle thyroid veins. Right inferior thyroid vein and corresponding artery ligated; last near carotid. Isthmus ligated with interlocking catgut ligatures. Right half thyroid cut away, and surface of stump seared with Paquelin cautery. Sutured wound. Sent to bed, with pulse 140, respiration 50, and recovered consciousness in forty minutes without nausea. Soon became very restless, and pulse and respiration quite irregular. Magendie, ℥v, hypodermically. Complained of pain in eyes; cocaine and cold compresses had little relief (pain in the eyes had been very frequent in this case throughout). 7 P.M., restless. Sod. brom. by rectum without effect. Allowed to sit up in bed. Water hypodermically had some effect.

Coughs a great deal, but without force. Sound like laryngeal paresis. Takes fluids by mouth.

15*th*. 6 A.M., slept one hour. No nausea. 8 A.M., pulse irregular, 160, difficulty in swallowing. 10.15 A.M., pulse 170; urine, 2 per cent. albumin; granular casts. 12.15 P.M., digitalis, gr. $\frac{1}{100}$ every four hours. Strychnine, gr. $\frac{1}{60}$, given hypodermically. 2 P.M., whiskey every two hours. Pulse very irregular and rapid. Respiration rapid and rather labored. Mind rather wandering; restless and talkative. 4.30 P.M., pot. brom. gr. xxx, per rectum. Very restless. Color cyanotic. 5.30 P.M., pulse imperceptible. Failed, and died 6.40 P.M. Temperature 106.2° F.

CASE IX.—Mabel C. C., aged eighteen years; single; New York; admitted to St. Luke's Hospital December 7, 1896. Referred by Dr. J. A. Booth.

Had measles. Since twelve years of age has had headache and biliousness occasionally. Menstruation began at fourteen, rather irregular.

One year ago began to have attacks of diarrhœa, which have occurred about once a week. About two years ago noticed change in neck, and three months later became nervous and easily frightened, with palpitation and dyspnœa. Eighteen months ago was told she had exophthalmic goitre. She is far-sighted. Appetite good. Neck measures fourteen and one-half inches. Ice-bag applied to heart region. Thymus administered. Aconitine, gr. $\frac{1}{200}$.

January 5, 1897. Heart apex in fifth space inside maxillary line. Apex-beat diffuse. Heart action rapid, regular, without murmurs.

28*th*. Urine acid, specific gravity 1024, no albumin, no sugar, no casts. Ether anæsthesia. Transverse incision. Superior thyroid vessels tied on right side; inferior thyroid tied close to gland. Right half thyroid dissected out; isthmus tied with silk ligature, divided, and stump cauterized. At end of operation pulse 200, but forcible. Much pain in wound. Restless. Nauseated.

29*th*. Urine acid, specific gravity 1032, trace of albumin, no sugar, hyaline casts. Patient very restless; nauseated. Pain rather less.

30th. About same. Wound opened, and cloudy, bloody serum evacuated. Small drainage tube inserted. More comfortable after this.

February 19th. Wound healed by primary union, except at drain.

January 12, 1898. Readmitted. Some improvement followed operation, but lately she has grown worse again. Pulse more rapid, some dyspnœa, exophthalmus more marked. Respiration 32, pulse 100, temperature 99.6° F. on admission. Marked pulsation is felt in left superior thyroid artery, with a thrill. Ether anæsthesia. Artery easily exposed and ligated. Temperature did not rise above 100° F; pulse ran up to 120, gradually falling to 96 or 100. She was very restless and noisy, nauseated, and complained of pain immediately after operation. Had headache during stay in hospital. Primary union of wound. Discharged January 17th.

"When I saw her on May 8, 1902, the eyes were not so prominent, the remaining lobe of the thyroid was smaller, the nervousness was less, she was seldom disturbed by palpitation, and the pulse was 100." (Booth.)

Case X. Mary E. McK., aged thirty-six years; single; New York; bookkeeper; admitted to St. Luke's Hospital October 27, 1897. Referred by Dr. J. A. Booth.

Family History. Consumption.

Personal history negative.

Present trouble began ten months ago with malaise, nervousness, beginning prominence of eyes. Has always had a rapid heart, and noticed no change in this. Patient became so nervous that she had to give up her work. Goitre not marked. Appetite good. Bowels loose.

October 27th to *November 13th.* Pulse began at 130, and was reduced to 100 and 110; respiration ran from 22 to 26; temperature 98° to 99.2° F.

November 13th. Ether narcosis. Transverse incision, vessels ligated. Isthmus divided by cautery, without ligature. Left half of thyroid removed. No drain. Wound sutured. Pulse very rapid, 106, but good force. No nausea. Restless.

14*th*. Feels well. No pain. Face flushed, and very thirsty. Temperature 101.4° F. all day; fell at night to 98.5° F.

15*th*. Rose at midday to 101° F., but soon fell, and remained below 100° F. thereafter. Pulse 150 to 160 while temperature was high, then fell to 120 to 130.

17*th*. Pulse came below 120, and ran 100 to 110 until discharged.

19*th*. Sitting up. Much improved.

24*th*. Discharged. Primary union. Great improvement.

"When seen on April 26, 1902—four and one-half years after operation—she stated that she had been very much improved in every way. She is less nervous, sleeps as well as ever. She is now able to write and keep her books neat; formerly she was not able to do this because of the tremor. . . . She has hardly any palpitation now, and the pulse varies from 80 to 90. Prominence of eyes hardly noticeable." (Booth.)

Patient works as cashier, where she has considerable need of haste and responsibility, which appeared to be the original cause of the disease.

Case XI.—Annie S., aged twenty-three years; single; New York; saleswoman; admitted to General Memorial Hospital April 13, 1898. Referred by Dr. Leszynsky.

Weight 110 pounds. Height medium. Health good previous to present trouble. First menstruation at seventeen years; irregular always, amount slight. Has had measles. Some chronic throat trouble, with enlarged tonsils. Had one bad attack of intermittent malarial fever. Had rheumatism two years ago in one ankle. Five years ago noticed a small swelling in thyroid region which has rapidly increased during last two years. About two years ago noticed rapidity of pulse, and has had much palpitation. Heart seems to shake entire body with its forcible pulsation. Has attacks of dyspnœa on exertion. Throbbing of vessels in neck is very annoying. Has been growing very nervous in last two years, restless, but sleeps well. No headache, except when throat is sore. Hyperidrosis present. For two years eyes have been observed to be growing prominent. For last year has been near-

sighted, and the eyes remain open during sleep, as it is an effort to keep the lids closed. Lacrymation. Appetite good, but tendency to diarrhœa of late. Tremor of hands during last year; sometimes all her limbs shake so that she can hardly stand.

Examination. Exophthalmus quite marked, left eye more prominent than right. When asleep the eyes are one-third open. Upper lid does not follow eyeball in looking down. No nystagmus. There is reduction of convergence. No ophthalmoscopic changes in retina. Thyroid gland enlarged, right lobe to size of turkey's egg, left to size of hen's egg. A thrill is felt on right side, and tumor has pulsation transmitted from the vessels of the neck. Venous hum heard in veins of neck. Heart dulness increased. Systolic thrill at apex. Systolic murmur, blowing in character, over pulmonary valve, transmitted upward. Heart action exaggerated.

April 23, 1898. Pulse 128, respiration 22, temperature 98.6° F. Ether anæsthesia. Transverse incision. Right lobe freed and vessels tied. Free oozing from veins on surface of tumor, controlled by gauze applied firmly around it. The isthmus was divided with the thermocautery. The tumor of the right lobe was removed; it was very vascular. The inferior thyroid artery of the left side was then ligated. Suture of wound. No drain. Time of operation, sixty-five minutes. Patient in good condition. 9 P.M., pulse 174, respiration 40, temperature 98° F.

24*th.* 2 A.M., pulse 136, respiration 50, temperature 100° F.; 6 A.M., pulse 168, respiration 36, temperature 100° F.; 10 A.M., respiration 40, temperature 101.6° F.; 2 P.M., pulmonary œdema, respiration 40, temperature 100.2° F.; 6 P.M., respiration 45, temperature 100.6° F.; 10 P.M., respiration 60, temperature 104.2° F.

25*th.* 3 A.M. Died 3.20 A.M. Albuminuria and suppression of urine after operation.

SYMPATHECTOMY.

CASE XII.—Mary F., aged twenty-five years; married; Ireland; housework; admitted to Bellevue Hospital May 12, 1899. Referred by Dr. J. G. Janeway.

Family History. Father died of rheumatism.

Past History. Habits temperate. Has always been subject to attacks of headache and diarrhœa. Has had three children, last one a miscarriage two and one-half years ago. Was never injured.

Present History. Two years ago first noticed a soft, movable lump in right side of neck just above the collar-bone, about the size of a marble. At this time was troubled a great deal with sore throat and severe headache. Lump gradually increased in size; was never painful or tender. Six months later a similar lump appeared at same place on left side of neck. These have increased in size. A year ago patient's friends noticed eyes were beginning to protrude and pupils were larger. Has been troubled with shortness of breath and pains in knees, especially when climbing stairs. Patient has gradually become very nervous.

Examination. Shows thyroid gland enlarged, more especially the right half, which is about the size of a hen's egg, the left half a trifle smaller; not painful or tender. Eyes are staring and slightly protruding, pupils dilated, and respond to light and accommodation. Patient is very nervous, easily frightened. Heart beats between 76 to 88 per minute, but soon quickens when patient walks about or is frightened. Heart-beats are strong, murmur at apex transmitted to axilla; a murmur to right of sternum. Lungs normal. Urinalysis negative.

Operated upon May 17, 1899, under ether narcosis. Incision made five inches long in right side of neck over posterior border of sternocleidomastoid muscle, and carried slightly forward. The sympathetic nerve was found and removed with the middle and inferior ganglion. The ether began at 2.20 P.M. During operation the pulse varied between 90 and 96; before operation pulse was 88. No change while cutting the nerve. While closing the wound with fine silk sutures, pulse was 100 and not so full. Operation on the right side finished at 3.55 P.M. Incision made the same way on left side; nerve found and removed, together with the middle and inferior ganglion. During the operation on left side pulse was 100 to 120, varying in quality; after excision of nerve, weaker and more rapid, running up to 140. Strychnine, gr. $\frac{1}{30}$; atropine, gr. $\frac{1}{200}$.

Pulse dropped to 125. Wound closed with small silk sutures. Operation finished at 4.15 P.M. Time of first operation, one hour and thirty-five minutes; time of second, twenty minutes. Patient took anæsthetic well, and made good recovery At 9 P.M. temperature 99.8° F., pulse 80, respiration 24.

May 18th. Patient complains of pain over heart. At 9 A.M. temperature 100° F., pulse 102, respiration 28.

20th. Dressed wound, healing with primary union. Every second suture was removed. Pain around heart has disappeared. Temperature 99.4° F., pulse 80, respiration 20. Patient feels much better.

27th. Wound entirely healed. Patient comfortable. Tumor in right side of neck is smaller and more firm; left has not changed.

29th. Discharged cured.

Patient was last seen about a year after the operation. The tremor and nervousness had much improved, the goitre was somewhat smaller, the pulse was about the same. There were marked and apparently increasing murmurs about the heart. The eyes were practically normal.

CASE XIII. Clara R., aged twenty years; single; New York; dressmaker; admitted to St. Luke's Hospital September 24, 1902. Referred by Dr. Noyes.

Family history negative.

Previous History. Had measles. First menstruation at fifteen; regular until eight months ago, when present trouble began. Always well and strong previous to present trouble, when she first noticed small swelling on right side of neck, which slowly increased. At the same time her eyes became prominent, and she began to lose strength; has lost thirty-five pounds. She developed tremor of the hands and lips, and became very nervous. Her heart beat very fast and palpitated at times. Hyperidrosis of hands and feet. Menstruation very irregular, coming only four times since last January, the last time in July. Has been unable to work. Appetite good, bowels regular, sleeps well.

Examination. Patient of small frame, poorly nourished, extremely nervous. Eyes very prominent and restless; pupils equally

dilated. Lungs negative. Pulsation of heart felt over entire præcordium, apex-beat in sixth intercostal space in the nipple line. Pulse rapid, forcible, regular. A loud, blowing systolic murmur can be heard with first sound, most marked at apex, and also distinct over the aortic valve. Thyroid gland uniformly enlarged, U-shaped, each lateral lobe equally enlarged and of the size of an orange. The gland is soft, and can be reduced in size by pressure. There is a well-marked thrill at the upper end of each lobe. A harsh, blowing systolic sound can be heard over entire tumor, and extending down on the chest below the clavicle and upward on each side to the mastoid processes. Urine acid, specific gravity 1022, faint trace of albumin, no sugar. Microscopic examination negative. Tinct. dig., ηv; sod. brom., gr. v, t. i. d., after meals.

September 30th. Hæmoglobin 70 per cent. Urine acid, specific gravity 1020, marked trace of albumin, no sugar. Microscopic examination: a few hyaline casts. 1.50 P.M., to operating-room, pulse 120, respiration 30. 2.25 P.M., N_2O_2 administered, followed by ether. 2.50 P.M., operation began. Incision made along posterior border of left sternomastoid from mastoid process to clavicle. Sternomastoid drawn toward median line; carotid and vein exposed and drawn inward and forward, and the sympathetic nerve found without difficulty. Very little bleeding, although all the vessels were distended. The uppermost ganglion exposed by blunt dissection, a Kocher clamp put on its upper end, and the nerve broken above this by twisting. The nerve was then dissected out, the inferior thyroid artery being divided between two ligatures, and the middle and inferior ganglia removed with it, the nerve being cut below with scissors. During the twisting out of the upper end the left pupil was in a state of hippus and irregular in outline. The wound was left open, and the operation continued. The pulse was rapid, but of good force. The respiration rapid and superficial, and the surface somewhat cyanotic. Practically no anæsthetic was given after the first half of the operation. The right nerve was removed in a similar manner, but more rapidly, as there were fewer vessels on that side. Just after the nerve was removed—about four o'clock—the patient suddenly ceased breath-

ing. The heart continued to beat, and artificial respiration was tried by the Sylvester method and with the Fell-O'Dwyer apparatus. Strychnine and oxygen were administered, but the heart soon ceased to beat, and the patient was dead. There was considerable tenacious frothy mucus coughed up during the operation, and it seemed probable that the smaller bronchi had become filled with it. There was no obstruction in the upper air-passages.

Case XIV. Maggie B., aged twenty-eight years; single; Ireland; domestic; admitted to St. Luke's Hospital November 26, 1902.

Family history negative.

Personal History. Has had scarlet fever and diphtheria; otherwise well until present trouble began, four years ago. First menstruation at twelve; regular, three-weekly type, dysmenorrhœa. Three years ago exploratory laparotomy done; does not know what was found. About four years ago noticed peculiar gurgling in throat, and a little later neck began to swell. A year later she could feel a mass in front of the neck. Last winter was told her eyes were prominent. Has pain in back and chest and over the liver, which "swells." Feels very nervous. Heart palpitates. Has frequent headaches. Bowels constipated, but for last year has incomplete control of sphincter ani. Has lost flesh and strength. Has been under treatment lately in medical wards without improvement.

Examination. Poorly nourished. Moderate exophthalmus. Eyelid does not follow bulb in looking down. Pupils equal, and react to light and accommodation. The thyroid gland is enlarged, forming a tumor the size of a small orange, most prominent in the midline, extending somewhat farther to the right than to the left. Marked pulsation in the carotids. No thrill or bruit in the tumor, but it seems to pulsate slightly. Apex-beat in fifth space, three and one-half inches from middle line, and slight impulse felt all over præcordium. A soft blowing systolic murmur is heard at the apex, transmitted toward midline. In second left intercostal space a loud systolic murmur is heard, which is not transmitted into the cervical vessels. The aortic sounds are normal. Lungs negative. Well-marked tremor of fingers.

November 26th to December 2, 1902. Temperature 98.5° F. to 99° F., pulse 92 to 112. Hæmoglobin, 80 per cent. Urine acid; specific gravity, 1012, no albumin, no sugar. Aconite, strychnine, ice-bag to heart.

2*d*. Ether narcosis. Bilateral cervical total sympathectomy. Incisions along anterior border sternomastoid muscle from angle of jaw to sternum. Some hypertrophied lymph glands were in the way, and were dissected out. Left sympathetic nerve dissected out and clamped at upper pole of superior ganglion. This caused immediate contraction of left pupil, followed by dilatation, irregularity, and final contraction. The movements of the pupil were not extreme. Upper end twisted out. Entire nerve removed with all three ganglia. Right nerve removed in same way, with similar effect on the right pupil. No alteration of pulse or respiration when nerves were severed below with scissors. Anæsthesia was maintained very lightly. No mucus in throat. Wounds closed with fine silk sutures, and no drain. Operation lasted one hour and forty-five minutes. Pulse 120, respiration 26, at beginning of anæsthesia; 108 and 36 when patient was sent to the ward at 6 P.M. 8 P.M., temperature 99.6° F.; 12 P.M., 101.8° F., pulse 108.

3*d*. 4 A.M., temperature 100.4° F. in rectum (pulse 114), never rose above 101° F., and fell to 100° F. December 5th, to remain down thereafter. Improvement in eyes already. Pulse 138 to 108; 4th, 112 to 106; 5th, 106 to 80; 6th, 94 to 80; remaining thereafter between 90 and 100, even when she first left the bed.

15*th*. Primary union of wounds. Thyroid and exophthalmic improvement marked. Patient less nervous.

22*d*. Discharged. Eyes normal. Tremor very slight. Heart action regular and of good force. Murmurs less distinct. Feels much better.

CASE XV. Ella F., aged twenty-three years; single; New York; domestic; admitted to St. Luke's Hospital November 27, 1902. Referred by Dr. Wood.

Family history negative.

Personal History. Measles and whooping-cough in childhood. Diphtheria one year ago. Soon after partial thyroidectomy was

done, the right half being removed, in another hospital. First menstruation at seventeen; always irregular, from two to eight weeks' interval, and last year went eight months without.

About two years ago noticed prominence of eyes and swelling of neck. Gradual increase since. Has many nervous symptoms—irritability, flushing of face, trembling hands. These improved somewhat after former operation, but she is now as bad as before Appetite good, bowels regular, last menstruation two weeks ago. Feels weak, and has dyspnœa on exertion.

Examination. Moderately well nourished; under medium size. Moderate erythema of face. Very marked exophthalmus. Pupils moderately dilated; react to light and accommodation. Upper lid does not follow globe in looking down. There is a horizontal scar of the right thyroidectomy. The left lobe of the thyroid remains, enlarged, size of a hen's egg. No bruit or thrill or pulsation in the tumor. Marked pulsation of vessels of neck.

Forcible impulse over entire præcordium. Apex-beat in fifth intercostal space in the mammary line. Heart sounds normal; no murmurs, except a soft blowing systolic murmur in second left intercostal space transmitted upward in the neck on that side. Lungs normal. Moderate tremor of the fingers.

November 27th to December 2d. Temperature from 98.5° to 99.8° F., pulse 110 to 140 (reduced by rest in bed, ice-bag to heart, bromide, aconite), respiration 24 to 30. Hæmoglobin 100 per cent. Urine acid, specific gravity 1030, no albumin, no sugar, but many casts were found. Before operation pulse was 152, respiration 26, leucocytes 7200. Operation. Ether anæsthesia. Incision along internal border left sternomastoid. Left sympathetic nerve dissected out, after removal of an enlarged lymph node. Kocher's clamp placed on nerve above superior ganglion, and nerve avulsed. Nerve accidentally divided just above the inferior ganglion, and the latter seized with a Kocher clamp and twisted out. Suture (fine silk) without drainage. Duration of operation just one hour, fully twenty minutes being devoted to accurate suture after anæsthetic was suspended. When nerve was divided above, the pupil dilated, became irregular, and then contracted. Patient's pulse

remained good, some cyanosis and some tenacious mucus in throat which required constant sponging. At end of operation pulse was 130, good force, temperature (rectal) 99° F., respiration 24. Slight nausea. Later had some pain.

3d. Urine acid, specific gravity 1030, many hyaline casts. Leucoytes 15,800 at noon. Saline enemata have been given; now aconite, sodium bromide, strychnine sulphate and ice-bag to præcordium are resumed. Fairly comfortable day.

6th. All sutures removed.

11th. Primary union of wound.

19th. Hæmoglobin 100 per cent. Urine acid, specific gravity 1020, no albumin, no casts. Before operation pulse was 98, respiration 26. Operation: Nitrous oxide anæsthesia followed by ether. Right sympathetic nerve removed by same method. Pupil dilated when nerve was severed. No irregularity occurred, however, and contraction followed slowly. The operation required ninety minutes, being prolonged by trying to dissect out the inferior ganglion first; but its recognition was found to be very difficult, as considerable of the vessel was injured, so that the former method was reverted to, and the operation then easily completed. At end of operation temperature 98.6° F., pulse 144, respiration 40. Slight nausea. Very restless.

20th. Very restless and thirsty all day. Wound dressed and several drachms of blood allowed to escape from it; rubber tissue drains inserted. Urine acid, specific gravity 1022, trace of albumin, no casts. Bromide of sodium.

21st. Still restless. Aconite resumed.

22d. More comfortable.

24th. Sutures removed.

January 8, 1903. Discharged. Less nervousness and tremor. Pulse slower, about 100. Eyes very much less prominent, especially the left.

April 20th. Examined. Patient looks well, and feels much improved. She is doing her full work as chambermaid. Still has some dyspnœa on exertion; breathing with mouth shut is difficult, some obstruction in left nostril. Neck measures twelve to twelve

and one quarter inches in circumference, and the remaining half of the thyroid is much smaller. The scars are pink and rather wide. Pulse 120, regular, normal in tension after walking to office and under slight excitement. Heart action much less tumultuous. Eyes much improved since last seen. Eyelids follow globes promptly in looking down. Pupils not unusually contracted. Flushing of face less marked. Slight restlessness of manner. Sleeps well. Eats well. Bowels regular. The outspread fingers are held steady, practically without tremor. The eyes are no more noticeable than extremely myopic eyes. The right eye protrudes more than the left, especially in looking down. Patient has headaches, but had them before operation—dull, throbbing, sometimes severe enough to prevent her from working.

Case XVI.—John J. G., aged twenty-three years; single; Hebrew; New York; clerk; admitted to St. Luke's Hospital January 10, 1903.

Family history negative, tuberculosis.

Personal History. Muscular rheumatism seven years ago; gonorrhœa six years ago, and twice since; alcoholic habit since fifteen years old; moderate smoker; excessive masturbation.

Present History. Six years ago was first told that his neck was swollen and his eyes protruding. He felt rapid heart action and palpitation. Was treated once with thyroid extract and rendered worse. Has always been nervous. Does not think he is any worse than at first, except that the goitre has increased; yet in the last three months the latter has slightly decreased. Has general weakness, attacks of dyspnœa on exertion, and bowels are irregular and appetite poor.

Examination. Medium frame. Moderate exophthalmus, both eyes; pupils equal, reacting sluggishly to light and accommodation. Stellwag's and Graefe's signs not present. Marked visible pulsation of vessels of neck. Thyroid gland markedly enlarged, nearly uniformly.

Pulse rapid (138), good force. Heart apex in fifth intercostal space, five inches from midline, impulse diffuse and heaving. Faint systolic murmur at apex transmitted short distance into axilla,

and heard over base also. Lungs negative. Coarse temor of hands.

January 10 to 15, 1903. Pulse 88 to 102 since admission, temperature 98° to 99.4° F., respiration 20 to 36. Urine acid, specific gravity 1020, no albumin, sugar, or casts. Aconite, sodium bromide, ice-bag to heart.

15*th*. 2.10 A.M. to operating-room; pulse 120, respiration 28. Operation. Ether narcosis preceded by nitrous oxide. Attempt made to find superior left sympathetic ganglion by posterior incision, and failed. Incision then made at anterior border of sternomastoid, nerve found, and removed in usual manner, except that the incision was united to posterior incision by transverse cut at its upper angle, and skin dissected up to allow access in front of sternomastoid toward angle of jaw. The left pupil was already much contracted, and no change followed avulsion of the nerve. All three ganglia and the entire nerve were removed. The wound was sutured, and then the right nerve and all three ganglia (the lowest intimately combined with the first dorsal ganglion) removed by the usual method—incision along anterior border of sternomastoid. The greatly dilated internal jugular vein was a source of great difficulty in reaching and identifying the nerve. Avulsion of the nerve caused no change in the contracted pupil. A drain was placed in the left wound. The operation lasted over two hours, but the patient bore it apparently well. There was the usual tenacious mucus in the throat. The pupils remained remarkably contracted throughout. Pulse at end of operation 164, irregular, fair force. Respiration 38. Regained consciousness very rapidly. 5.50 P.M., conscious, no nausea. 6 P.M., saline enema. 7 P.M., saline enema. 7.30 P.M., very restless. Pulse 170, more regular. 8.10 P.M., Magendie, ♏v, hypodermically; no effect. 9 P.M., vomited brown fluid. Dressing stained with blood of left side. 10 P.M., tr. aconite, ♏iv, every two hours. 11 P.M., sod. brom., gr. xxx. Does not sleep. Urine acid, specific gravity 1022, no albumin or casts.

16*th*. 9 A.M., sod. brom., gr. xxx. No sleep. Vomited after bromide; greenish. Epistaxis. Extreme restlessness. 2 P.M., sod.

brom., gr. xxx, given every six hours. 2.20 P.M., hyosc. hydrobrom., gr. $\frac{1}{100}$; quieter. 3 P.M., dressed; two sutures removed. Allow bed-rest. Magendie, ηv, hypodermically. Nutrient enema every six hours. 6.30 P.M., restless all day. Takes food well. 8.30 P.M., restless. Strych. sulph., gr. $\frac{1}{30}$, hypodermically. 11 P.M., restless. Magendie, ηvj. Forty-eight fluidounces urine during twenty-four hours.

17*th*. 2 A.M., restless. Respiration labored. Alcohol sponge bath; good effect. Digitaline, gr. $\frac{1}{20}$, hypodermically every two hours. 4 A.M., pulse better. 6 A.M., pulse rapid again; restless. Hyosc. hydrobrom., gr. $\frac{1}{100}$, hypodermically; slight effect. 12 noon, throat examined; apparent paralysis of vocal cord. Urine acid, specific gravity 1022, faint trace albumin, no sugar, granular casts. Nutrient enema (well borne until now) expelled. 2 P.M., give digitaline every four hours. 3 P.M., pulse 188, irrational; whiskey. 6.30 P.M., leucocytes 6400. 7 P.M., stop digitaline. Respiration labored. 9.20 P.M., saline intravenous infusion, 500 c.c. 10.30 P.M., chill lasting five minutes; pulse and respiration very rapid, temperature 106° to 107° F. 12 P.M., profuse perspiration; extremities cold. Urine in twenty-four hours, sixty-one fluidounces. 12.45, hydrobrom. hyosc., gr. $\frac{1}{100}$, hypodermically. Very restless. Temporary effect.

18*th*. 2 A.M., quieter, sleeping. 3.25 A.M., respiration suddenly became more labored. 3.30 A.M., died.

CASE XVII.—Lilly W., aged twenty-six years; married; German; housewife; admitted to St. Luke's Hospital January 12, 1903. Referred by Dr. J. A. Booth.

Family history negative.

Personal History. Measles as a child. Diphtheria several years ago. Menstruation began at thirteen; regular until four years ago, when it ceased for eight months. Married two and one-half years ago; one child born nine months ago, now dead. Goitre no worse during pregnancy.

Present History. Four years ago was "sick" for several months, and "ran down greatly," and then noticed protrusion of eyes and swelling of neck. The eyes remained about the same, the neck

continued to enlarge. No palpitation of heart except after exertion. Not very nervous. Appetite good; bowels regular. Feels pretty well, but has pain in eyes, and thinks eyes and neck disfiguring.

Examination. Medium height, large frame, well-nourished. Very extreme exophthalmus, especially in left eye. The signs of Stelwag, von Graefe, and Moebius all present. Pupils react sluggishly to light; very well to accommodation. Tongue is tremulous. Thyroid gland much enlarged, in three distinct lobes. Circumference of neck at most prominent part is sixteen and one-half inches. Tumor firm, not pulsating. Apex-beat in fifth intercostal space, five inches from midline. Faint, low-pitched murmur, presystolic, at the apex, and soft blowing systolic murmur over the base. Pulse rapid (116), regular, good force. Lungs negative. Moderate tremor of fingers. Urine acid, specific gravity 1024, faint trace of albumin, no sugar, no casts.

January 12th to 17th. Aconite, bromide, ice-bag to heart.

17th. Hæmoglobin 85 per cent. Before operation, pulse 124, respiration 24. Operation, 2 P.M. Ether narcosis preceded by nitrous oxide. Both incisions made at once along anterior border sternomastoid, and skin and deep fascia divided to allow ready retraction of the large thyroid gland. The right sympathetic nerve and all three ganglia were first removed, as usual; then the left. A small portion of the left superior ganglion was left behind. Both pupils were contracted throughout, and no change was produced in them. The wounds were closed with interrupted fine silk sutures without drainage. The anæsthetic was well borne; but the usual tenacious mucus required sponging. Very little ether was used. After operation temperature (rectal) 101° F., pulse 100, respiration 24. At 8 P.M. temperature rose to 102.6° F. (pulse 106), but fell to 101.6° F. at 12 P.M., then to 100° F., and there remained until the twelfth day, when it became normal. The pulse ran from 104 to 130, then settled to 120 before discharge.

February 1st. Leucocytes at 10.30 P.M., eight hours after beginning operation, were 8500. There was primary union of wound, and patient felt at once relieved of a feeling of tension in the eyes.

The exophthalmus remained, but the eyes assumed a less staring and more natural appearance.

Examination, May 11, 1903. The neck measures fifteen and three-quarter inches. Pulse 100. Barely perceptible tremor in hands. Exophthalmus much less, especially right eye; can shut right eye completely, left almost; convergence normal; lids follow globes well. Feels very well, eating and sleeping excellently. Thinks left side of goitre has shrunk more than right.

Case XVIII.—Julia C., aged twenty-five years; single; English; stenographer; admitted to St. Luke's Hospital February 3, 1903. Referred by Dr. Joseph Collins.

Family history negative.

Personat History. Measles, whooping-cough, and scarlet fever in childhood; typhoid fever last summer. Menstruation began at fifteen years. Takes wine in moderation. Has worked hard and long hours.

Present History. Two years ago noticed swelling in neck, gradually increasing. Always nervous, but worse of late years, especially since typhoid fever. Now very hysterical and tremulous. Exophthalmus since the typhoid, but improved lately under medical treatment. For a year has had rapid heart action on exertion. Feels "burning up," and has itching of skin, especially at night. Severe frontal headache. Flatulence. Bowels regular. Appetite poor.

Examination. Medium height, slight frame. Slight exophthalmus. Pupils dilated and equal, react sluggishly to light and accommodation. Stelwag's, von Graefe's, and Moebius' signs not present. Tongue moist and tremulous. Marked tremor of hands and general restlessness. Face flushes readily. Thyroid gland slightly enlarged. Marked throbbing of neck vessels. Heart apex-beat in fifth intercostal space—four and one-half inches from mid-line—very diffuse and forcible. Action rapid. Systolic murmur at apex, transmitted into axilla, and heard with more intensity over pulmonary valves. Pulmonic second sound much accentuated. Marked systolic murmur over thyroid gland. Pulse rapid (120), small, fair force, without unnatural tension.

February 3d to 6th. Urine acid, specific gravity 1018, trace of albumin, no sugar, few hyaline and granular casts. Aconite, bromide, and ice-bag to heart were begun, but discontinued because stomach was upset. Nausea and vomiting would not allow medication or much feeding. Was prepared for operation on 6th, at 2 P.M., but had sudden fever just before going to operating-room, and operation was postponed. 6 P.M., leucocytes were 9000.

13th. Patient having improved, operation undertaken at 2 P.M. Pulse 108, respiration 32. Ether narcosis, preceded by nitrous oxide. Both incisions made at once. Left nerve and all three ganglia first removed. The nerves were separated into several fine fibres, not forming single cords, and it was difficult at first to find them. When the nerve was clamped, each pupil first contracted, then dilated as the nerve was avulsed. Usual technique, and no drainage. Patient bore anæsthetic badly, heart's action at first tumultuous, then quieter but rapid, and much mucus collected in the air-passages. She was allowed to come to and cry out during suture of the wounds, and her color improved very much. At end of operation pulse was 130, respiration 24. Operation lasted ninety-five minutes. Recovered without nausea, but was very restless, and sodium bromide was given by rectum (6 P.M.). 8 P.M., pulse 204, fair force. Restless. 9 P.M., strych. sulph., gr. $\frac{1}{30}$. 9.30 P.M., saline enema and whiskey; ice-bag to heart. 11 P.M., strych. sulph., gr. $\frac{1}{30}$, every two hours. Foot of bed elevated. Alcohol sponge bath for ten minutes. 11.50 P.M., ice-bag to nape of neck. 12.05 P.M., Magendie, ♏v, hypodermically.

February 14th. 12.30 A.M., nutrient enema and sodium bromide. 6 A.M., restless, irrational; stop ice-bag to nape of neck. Give strychnine every four hours. 9 A.M., Kemp's tube and irrigation of rectum for one hour. Magendie, ♏v, hypodermically. Urine acid, specific gravity 1030, trace of albumin, granular casts. 11.45 A.M., very restless. Saline intravenous infusion, 1000 C.C., with slight improvement. 12.40 P.M., Kemp's tube, rectal irrigation one hour. 1 P.M., Magendie, ♏v. 3.45 P.M., saline intravenous infusion, 1500 C.C. 5 P.M., pulse stronger; twitching of limbs. 7 P.M., quieter; pulse poor. 9.50 P.M., extremities cold. 9.55 P.M., died.

DISCUSSION.

Dr. Thomas W. Huntington, of San Francisco, Cal.

This field seems to have attracted but little attention on the part of American surgeons. Personally I have had no experience with sympathectomy, and shall confine my remarks to the extirpation of the thyroid.

In a paper published recently I quoted Albert Kocher to the effect that radical procedure in these cases should be undertaken before tissue changes have taken place, before thyroid intoxication has occurred, and before the characteristic symptoms of this disaese have become fully established. My experience in the operative treatment of Basedow's disease consists of six operations upon five cases. There have been no fatalities, nor have I noted the alarming postoperative symptoms, such as excessive rise of temperature and undue shock.

Thyroidectomy for Basedow's disease should always be done under local anæsthesia. In my earlier experiences I resorted to regionary anæsthesia, cocainizing nerve trunks; but as this occupies more or less time, I have latterly depended upon the local use of Schleich's solutions. The fact is that the pain attending this operation after the integument has been divided is inconsiderable. The patient can usually be reassured, and as the surgeon progresses it is found that the ordeal is not by any means terrible.

The absence of great shock interested me not a little. In no case was the patient's condition after operation such as to cause serious apprehension. As to end results, three patients are perfectly well at the end of one year. Exophthalmus persists in one case, and no doubt will be permanent. This, however, is less marked than prior to operation. The last two cases have been done comparatively recently, but they are already markedly improved.

In no case has there been a retrograde tendency following temporary improvement.

Dr. Willy Meyer, of New York City.

Dr. Curtis' paper shows what a wonderfully complex disease goitre is. We know that partial extirpation of the gland will cure or relieve our patients. So far I have had only two cases where unilateral extirpation was done, and it greatly improved the patients. One of them—a woman—has still exophthalmus, but is opposed to a second operation. As Dr. Curtis only mentioned the operative procedures, I will refer to a third—the serotherapy method of Lenz, Professor of Surgery at the University of Amsterdam, Holland. He feeds his patients on the milk from goats in which the thyroid gland has been entirely extirpated. His

reasoning is as follows: We know that enlargement of the thyroid produces the peculiar symptoms of Graves' disease, and if we overfeed patients with the thyroid extract, for instance, in trying to improve obesity, we can in a number of cases produce artificial Graves' disease. Evidently a poison enters the human system which, being in excess, is not chemically bound, but acts as a poison. Now, if we extirpate the thyroid entirely, peculiar symptoms arise, differing in animals according to the food. In the carnivorous animals acute tetany is produced, while in the herbivorous a chronic cachexia sets in. Dr. Lenz has found that if we introduce into the human system the milk of a goat the thyroid gland of which had been removed, it combats the poison, and the increased thyroid secretion will enter into a chemical combination with the cachexia poison contained in the milk. His reasoning has been borne out by clinical experience in six cases in which cures have been effected. Of course, it is not easy, especially in large cities, always to extirpate the thyroid gland of a goat and then put the animal into a place where the milk can be obtained and brought to the patient. In this direction, it is a comfort to know that well-known large chemical firms are supplying a serum which is taken from goats which have had their thyroids extirpated. If the patients are injected with this serum or take it internally, improvement will take place. At about the same time that Prof. Lenz was experimenting two French surgeons had worked on similar lines. They extirpated the thyroid in dogs, and then injected their serum into patients suffering from exophthalmic goitre, also with beneficial results.

Dr. Leonard W. Bacon, Jr., of New Haven, Conn.

I was much interested in this paper and in its discussion. The different therapeutic measures already alluded to have been for the treatment of Graves' disease "in general." Now, it has seemed to me that there are different classes of Graves' disease which are severally amenable to different forms of treatment.

There are two pathological theories of this disease, one asserting that it is of nervous origin, and the other that it is due to hyperthyroidization. It is probable that both these theories are in a measure correct, but there is a certain margin of cases not fully accounted for by the one theory or by the other; and there are, I think, criteria by which we may determine in what particular category a given case of the disease should be classed. If we could establish the criteria by which to decide what the cause of each case was we might arrive at a little more rational method of cure.

The thyroid origin of Graves' disease may be regarded from two points of view: first, we may be dealing with a case of simple excess of secretion, and, second, with a case of perverted secretion. No doubt a

third set of cases are primarily of nervous origin; but the point is, Can we actually establish these groups? I think we can.

Take, in the first place, those cases due to pure hyperthyroidization. You will have four criteria by which to identify them. First, the strictness with which the symptoms presented by the patient are parallel to those known to follow the exhibition of thyroid extract; second, the exactness of the antithesis between the patient's symptoms and those known to be due to deficient thyroid secretion, as exemplified in cachexia, strumiprivarum, cretinism, and spontaneous myxœdema; third, the effect of the cautious experimental administration of thyroid extract upon the patient in hand, bearing in mind that in cases of simple hyperthyroidization it would be natural to expect that the administration of thyroid extract would aggravate the symptoms; and, fourth, the evidence of actual local difficulties in the cervical region, of which the enlargement of the thyroid gland and the widening of the cervical vessels are the most important.

In cases presenting these symptoms—cases which we may consider to be due to pure hyperthyroidization—measures such as thyroidectomy or exothyropexy, which are calculated to diminish the excessive activity of the thyroid gland, are, to my mind, logical and rational.

As to the symptoms which Graves' disease presents when it arises from perversion rather than from mere excess of the thyroid secretion, it will suffice to say that they are the same as those of perverted function in any organ, namely, great irregularity and disproportion in the sequence and the correlation of the symptoms; and we may consider that we are dealing with perverted rather than merely excessive thyroid secretion where there is marked predominance of any one symptom, such as the tachycardia, or, it may be, the exophthalmus, over the other symptoms ordinarily met with in Graves' disease. This second category contains, then, most of those cases which the French denominate the "formes frustes."

The indication for operation on the thyroid gland in these cases is much less distinct than it is in those due to simple hyperthyroidization. In this present category of cases of Graves' disease by perversion of the thyroid secretion there is one special group to which particular attention should be called, namely, those cases where the symptoms of Graves' disease are mingled with those of myxœdema, indicating an imminent exhaustion of the overstimulated thyroid gland; here thyroidectomy would be likely to be followed by most unsatisfactory results.

The third category which, I think, we may define in cases of Graves' disease is that of Graves' disease of evidently nervous origin. The time limit will not allow me to specify the characteristics of this group of cases, but it seems to me reasonable that the operation of sympathec-

tomy discussed in the paper should find its more special field of application in cases of Graves' disease of this "nervous type" rather than in the cases of the thyroid type whether by excess or by perversion of the thyroid secretion.

Dr. A. J. Ochsner, of Chicago.

I believe Dr. Curtis' view of the serious side of the condition following this operation is undoubtedly correct. Some seven or eight years ago I had a patient die of acute thyroidism. Previously the symptoms which Dr. Curtis has described had occurred repeatedly in similar operations in my practice. The acute thyroidism undoubtedly resulted from excessive manipulation of the thyroid gland. In this case there were two large lateral lobes and a spherical central lobe compressing the trachea. It was not a case of exophthalmic goitre. The operation was done under general anæsthesia, and in order to overcome the distress due to dyspnœa the operation was done more hurriedly than usual. The patient had typical symptoms of acute thyroidism after the operation. Since that time, besides taking all the necessary precautions in every thyroidectomy, such as the prevention of hemorrhage, sepsis, etc., the only other precaution I have taken is to absolutely avoid pressure upon the gland either with the hand or with retractors, and, consequently, such conditions have not occurred again. I have had five cases of thyroidectomy for the cure of exophthalmic goitre, and none of them had acute thyroidism. In one case the pulse went down from 160 to 80 beats per minute directly after the operation. This was eight years ago, and the patient has been well ever since. I have repeatedly noticed the marked reduction in the frequency of the pulse following this operation. I use drainage in all of my cases by placing a small pledget of gauze in the lower angle of the wound. This carries away some of the blood and prevents absorption. I always make a very large incision, so as to remove the gland without much manipulation, and I think this is important. It has occurred to me that possibly the greatest benefit in using local instead of general anæsthesia may be due to the fact that with the latter the surgeon is compelled to reduce the manipulations to a minimum, thus unintentionally reducing the cause of thyroidism.

Dr. George Woolsey, of New York City.

Dr. Curtis spoke of his fatal case from anæsthesia, and mentioned Kocher's statistics of cases successfully operated upon under local anæsthesia. My experience agrees with this. A patient of mine, a man who had a large exophthalmic goitre, was operated upon under local anæsthesia, when the right lobe was removed and the man made

a good recovery. He was not entirely well when the symptoms returned three or four months later. After trying Kocher's recommendation of the use of phosphorus without result, I finally decided to do a sympathectomy on the left side, which I did under general anæsthesia, using nitrous oxide and ether. The patient died under the anæsthetic before the operation was entirely completed. As long as we can operate comfortably under local anæsthesia, and general anæsthesia is unsafe, I think we should prefer the former in operating for exophthalmic goitre.

Dr. Emmet Rixford, of San Francisco, Cal.

I was glad to hear Dr. Bacon refer to the selection of cases, as there is a great difference between primary and later goitre. In the latter cases the dangers of operation are vastly less than in the primary ones. The greatest danger is unquestionably the anæsthetic. The operation of sympathectomy is a terrible one, and needs general anæsthesia. The amelioration of the symptoms is due to ligation of the inferior thyroid arteries, which is done in removing the process of the nerve. As to the association of myxœdema with goitre, I had one case in which the patient had universal œdema. Her face was so stiff that she could scarcely open her mouth; the arms and hands were swollen and the thighs were hard. The removal of a large thyroid was advised, and it was done under local anæsthesia, the respiration being 50 and the pulse 180, and was followed within twelve days by a loss of thirty pounds, due, no doubt, to loss of fluid. The patient is now practically well, two years afterward. As to local anæsthesia, I have used only a 1 per cent. solution under the skin, and the patients state that the dissection in the deeper tissues is not especially painful. Patients will all say that the sense of suffocation is the worst thing they experience. Superficial anæsthesia is all that is necessary. There is considerable advantage, in operating with local anæsthesia, in covering the patient's head with a screen, so that he sees neither the instruments nor the sponges. The patient's mental condition may be modified very much by conversation, and I find this works admirably. All of my patients have had a slight increase in the thyroid symptoms after the operation, but they have lasted only a very short time. I have operated on four cases with no bad results, and no serious symptoms followed.

Dr. F. J. Shepherd, of Montreal, Canada.

I have performed thyroidectomy in six cases of Graves' disease, and lost one from thyroidism, general anæsthesia being employed in all cases. One patient was a woman, aged sixty-two years. Three of these cases have been well for some six to eight years, but one was only partially

improved. It makes a great difference whether the Graves' disease accompanies, precedes, or follows the enlarged thyroid, and the danger of the operation is very much influenced by this; if the exophthalmus follows enlarged thyroid, the case is much more favorable for operation. I have excised the thyroid in about one hundred cases, and never lost a case from the anæsthetic (general anæsthesia was employed in every case). The only fatal case I have had was the one above alluded to from thyroidism.

Dr. Joseph C. Bloodgood, of Baltimore.

As to the pathology of exophthalmic goitre, I had an opportunity during the past few years of studying this condition, and the cases we have seen have presented a uniform pathological picture. The colloid material of the normal thyroid disappears, and the ordinary round, spherical colloid acinus is replaced by another in which the epithelial cells are invaginated and there is an increase in their number. I will show this picture on the lantern slide later on. You can scarcely tell the difference between a lactating breast and an exophthalmic thyroid. We do not know the causes that produce the hypertrophy of the gland; this remains to be ascertained, but we can explain all the other symptoms by an overproduction of thyroid epithelial tissue. I am inclined to think that the proper operation in the early stages is the partial removal of the gland; that the division of the sympathetics is an operation to relieve the residual symptoms and exophthalmus rather than for the acute infection due to overproduction of thyroid tissue.

Dr. Curtis. Most of the points brought out in the discussion are covered in the paper. As to rough handling of the gland, this has been avoided in all my cases to the greatest possible extent. In my earlier work I was impressed with the fact that we had thyroid poisoning as a cause of the disease, but now I believe that in operating our efforts should be directed toward diminishing shock. In dividing the isthmus or cutting through the gland I have always taken the greatest possible care to avoid contact between the raw surface of the gland and that of the wound. As to thyroidism being due to rough handling in the preparation for operation, I do not think this is true, as the thyroidism comes too late for this. It does not come on immediately after the preliminary handling, as is shown, by the way, in that case of mine in which the rise of temperature occurred just before operation. In this case it came on fifteen hours after the sterilization, and was brought on by excitement. When the real thyroidism occurred it was within two or three hours after operation.

One of the gentlemen has mistaken my point in speaking of the death which I attribute directly to anæsthesia. We must divide these cases of thyroidism from those of ordinary death from anæsthesia, even if we charge the fatal result to indirect influence of the anæsthetic. Anæsthetics have an influence, more or less indirectly, upon the general system, and may thus contribute to a fatal result. All of the thyroidectomies of this series have been done over two years ago, as I gave up the operation about that time. It had not been proven then that cocaine was a safe drug to use, and I still have doubts whether it can be used for sympathectomy. To remove a normal sympathetic need not be a difficult operation, but to operate upon the neck with enlarged blood-vessels, with breathing interfered with by the goitre, is quite another matter. These operations are quite likely to be bloody, and I repeat again that I doubt if cocaine will be successful. The point made by Dr. Woolsey that the choice of operation might be governed by this fact is a good one, but in some cases at least we should certainly prefer thyroidectomy.

PROSTATECTOMY AND GALVANOCAUSTIC PROSTATOTOMY (BOTTINI'S OPERATION):

Their Present Status in the Radical Treatment of the Hypertrophied Prostate Gland.

By WILLY MEYER, M.D.,
NEW YORK.

The question of the proper selection of operation for the relief of patients suffering from an enlarged prostate and its sequelæ has lost nothing in importance or intensity of interest. Castration, including vasectomy, prostatectomy, and galvanocaustic prostatotomy (Bottini's operation), are still in the field. The relative value of these various procedures can be properly determined only by the final results—best by the results obtained by a single man in a fair series of cases. Personal extensive experience, unbiased observation, and reports of late results based on objective examination are the factors that will advance the proper estimation of each procedure.

Castration, although it has completely and permanently restored many a prostatic's urinary affection, will not be discussed here. It still has staunch advocates among men whose views surely command respect. However, since we have two methods to help such patients by attacking the gland directly, indirect influencing should be relegated to the rear, or, at least, should be our very last resort, especially as it deprives the patient of his virile power. Personally, I believe that a direct attack should first be made in every case. Failing in this, an operation on the testicles or the vas deferens may then be resorted to. In accordance with this view of mine, I shall, therefore, here consider prostatectomy and galvanocaustic prostatotomy (Bottini's operation) alone.

That prostatectomy is the most radical as well as the most surgical procedure from an operative point of view goes without

saying. The operation is typical. It aims to remove the hypertrophied tissue within the prostatic capsule. If this be accomplished, proper urinary drainage ought to become re-established. Recurrence of the former trouble seems more than unlikely.

This is not the place to discuss the technique and the advantages or disadvantages of the suprapubic and perineal route, respectively. If the gland can be removed by operating from below, this procedure deserves the preference, were it for the sole reason that the wound which is made for shelling out the gland can be at the same time best utilized for drainage. But, aside from this, perineal prostatectomy has the advantage of permitting operation under the guidance of the operator's eyes. At the present time it certainly seems to be the consensus of opinion that perineal prostatectomy is the operation of choice in the surgical treatment of the enlarged prostate. Yet such opinion, it seems to me, can be justified and of real value only if borne out by the results. Surgeons everywhere are about to enlarge their experience in this direction. The near future will, no doubt, bring us the data so eagerly looked for. Death rate and late results as well as possible sequelæ are the main points to be taken into consideration in judging the value of the suprapubic and perineal operations. With regard to the death rate, personal statistics again will be of special value, as surgeons who perform the same operation time and again will soon master and improve necessary technical details and learn to avoid or to overcome troubles arising during the after-treatment.

With regard to the complications that may arise in connection with prostatectomy, the following may be mentioned:

a. The occurrence of unilateral or bilateral epididymitis; also orchitis with abscess formation;

b. Persistent perineal fistula (avoidable by improved technique);

c. Dribbling, a feature which generally seems to be of a transitory character only;[1]

d. Recurrence of some of the former symptoms, as, for example, residual urine, pain in urinating, frequency of micturition;

[1] If permanent, partial retention resulting from a semisuccessful Bottini operation would seem preferable.

e. Stricture (curable by sounding);

f. Impotence (see later).

Galvanocaustic prostatotomy (Bottini's operation), on the other hand, does not attack the bulk of the gland; it only cuts grooves through the mass, leaving the gland itself in place. However, it must be remembered here, that it is not the bulk of the gland that is the disturbing factor in the trouble under consideration. Keyes, Sr., says:[1] "It is not the size of the prostate that makes it obstructive or causes it to yield subjective symptoms. Many a man with a very large prostate empties his bladder entirely, has no residual urine, and does not greatly complain; while another with practically no general enlargement, but with a third lobe or a prominent bar—thus making his prostate actively obstructing—will suffer the torments of the damned and embrace any operation and take any risk which promises to relieve him from his torture. It should, therefore, be the surgeon's object to remove the obstructing portion of the prostate rather than to take the organ away in bulk, since the bulk alone generally does little damage."

Bottini's operation, as a whole and in all its details, in contradistinction to prostatectomy, is by no means a typical operation. The number, length, direction, and depth of the cuts must differ with every case. Numerous other questions, too—as, for instance, Shall we hook and compress the prostate while ploughing through the same? shall we repeat the incision in whole or in part by going over the ground twice? shall we use blades of various size and length? how had we best proceed in the presence of a median lobe? etc.—are still mooted ones. To do Bottini's operation properly, as required in the individual case, is, therefore, often a very difficult task. To determine the various points at issue, it is necessary to make a careful examination of the patient with regard to size, configuration, and consistency of the gland, if this be palpable per rectum; a thorough cystoscopical examination is essential in every case, and sometimes may have to be repeated. In short, every single case has to be studied as to its requirements. If this be

[1] Remarks on the Treatment of Stone in the Bladder when Associated with Hypertrophy of the Prostate. Annals of Surgery, vol. xxvii. pp. 578 and 579.

No.	Name.	Age.	Total or partial retention.	Previous gonorrhœa.[5]	Enlargement of prostate palpable per rectum.	Complications.	Result of cystoscopy.	Number and date of operation.	Anæsthesia.	Recovery from operation.	Date and cause of death.	Sequelæ.	Immediate result of operation.	Late result: re-examination, March, April, 1900; March, April, 1902, etc.	Alive to-day, March, April, 1903.	Date and cause of death.	Catheter used.	Frequency of urination.	Character of stream.	Pain.	Vesical catarrh.	Gain in weight.	Bowels.	Power of intercourse.	General remarks.
1	E. H.	58	Partial; residual urine[1] 25 : 300;[2] catheter used twice per day.	Not noted.	No.	Cystitis.	Gland bulging into bladder; no median lobe; trabecular bladder.[3]	Two { Oct. 7, 1897 / Dec. 18, "	General.[4] "	Yes.	.....	.....	Much improved.	March, April, 1900, considers himself cured; r. u. 55 : 225 c.c. March, April, 1903, not heard from.	?	....	No.	4–5 × per day, 2–3 × nights.	Not noted.	No.	Slight.	Yes.	Normal.	Not noted.	Oct. 7, 1897. Operations with bladder empty; Bottini's original incisor; insufficient storage battery. Dec. 18, 1897. Freudenberg's incisor, imported battery.
2	H. G.	73	Partial; 10 : 160	Not noted.	Moderate size, very soft.	Cystitis; pyelonephritis.	Body distinct; no median lobe; diverticulum in fundus.	One, Dec. 23, 1897	Local.	Yes	.....	.....	No improvement.	.....	No.	Six weeks after operat'n pyelonephritis.	.....	.....	.....	.....	.....	.....	.....	.....	
3	J. S.	64	Partial; 150 : 450	Not noted.	Yes; soft.	Cystitis; bilateral pyelitis; chronic sepsis.	Unsatisfactory owing to hemorrhage; median lobe. (?)	One, Jan. 29, 1898	General.	No.	30 hrs. after operation; acute sepsis	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	
4	J. W.	64	Partial; 10 : 200; catheter 3 × in 24 hours.	Not noted.	Yes, medium consistency.	Cystitis.	No median lobe; many diverticula.	One, Feb. 26, 1898	Local.	Yes.	.....	Abscess of right epididymis six weeks later.	Cured.	March, April, 1900, not heard from. Jan. 2, 1901, cured; u. r 150 : 60 c. c. March, April, 1903, not heard from	.... ?	....	No.	3 × per day. 1–2 × nights.	Good.	Slight in glans.	Slight.	Yes.	.....	Not noted.	
5	J. K.	[illegible]	Partial; 100 : 180; catheter used frequently.	No.	No.	Cystitis.	Intraurethral nodule; no median lobe; paresis of internal sphincter muscle.	One, Mar. 28, 1898	Local.	Yes.	.....	Vesical hæmaturia on tenth day, due to irrigation of neck of bladder.	Cured.	March, April, 1900, 1.[illegible] cured: no r. u. March, April, 1903, l. cured; no r. u.	..... Yes.	....	No. No.	3–4 × per day, nights not at all. 4–5 × per day, nights once.	Good. Good.	No. No.	Urine clear. "	Yes. The same	Normal. Not normal.	Not noted. Yes.	No bladder irrigation. No further treatment
6	[illegible] F.	72	Partial; 100 : 17	Not noted.	Yes.	Right testicle removed one year ago. Cystitis; pyelitis.	Large gland; no median lobe.	One, May 7, 1898	Local.	Yes.	.....	.....	Cured.	Mar., April, 1900, cured; r. u. 150 : 50; at times voids more than 350 c.c. Mar., April, 1903, cured; r. u. 375 : 50.	Yes.	....	No. No.	3–4 per day, nights once. " " "	Forceful Forceful	No. No.	No. No.	Considerable. Yes.	Normal. Normal.	Not noted. Yes.	Operation with bladder filled with water; from this time on all operations were carried out in this way; no local after-treatment.
7	B. A.	68	Partial; 80 : 300 c.c. catheter used once or twice a day.	Not noted.	Yes.	Cystitis.	No median lobe.	Two { June 8, 1898 / " 21, "	Local. "	Yes.	.....	.....	Cured.	March, April, 1900, l. cured.	No.	1902, apoplexy.	No.	5 × per day, nights not at all	Good.	No.	No.	Yes.	Normal.	Yes; no ejaculation.	Local condition unchanged until death.
8	W.M.M.	68	.....	Not noted.	Yes.	Persistent suprapubic fistula; cystitis; chronic pyelonephritis. Previous operations by other surgeons: bilateral vasectomy; partial perineal prostatectomy; suprapubic cystotomy; bilateral orchidectomy; Bottini's operation.	Median lobe.	One, June 11, 1898	Local.	Yes.	.....	.....	Improved.	.....	No.	Two mos. after operat'n pyelonephritis.	.....	.....	.....	.....	.....	.....	.....	.....	
9	J. B. M.	64	Partial; 30 : 300; catheter 3 × per day.	Yes.	Yes.	Cystitis; chronic nephritis; (?) frequent previous chills.	Positive.	One, June 15, 1898	Local.	No.	8 dys. later, after suprapubic cystotomy.	Continuous vesical spasms.	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	
10	F. R.	66	Partial; 30 : 30.	Not noted.	Yes.	Cystitis; wears urinal.	Right lateral lobe much larger than left.	One, June 22, 1898	Local.	Yes.	.....	.....	Much improved; laid aside urinal.	March, April, 1900, not heard from.	No.	1902, cause not known.	.....	.....	.....	.....	.....	.....	.....	.....	
11	M. B.	62	Partial; 100 : 50; catheter 3 × per day.	Not noted.	Yes.	Cystitis; slight pyelitis.	No median lobe.	One, Sept. 22, 1898	Local.	Yes.	.....	.....	Cured.	March, April, 1900, improved; r. u. 200 : 20.	No.	1902, pneumonia.	No.	8–12 × per day, 3–5 × nights.	Fair.	No.	Moderate	Yes.	Normal.	Not noted.	Galvanocaustic knife became bent sideways, at angle of 45°.
12	C. S. I.	50	Partial; 30 : 100	Yes.	Yes.	Cystitis; profound anæmic cachexia.	Median lobe; two diverticuli.	One, Oct. 4, 1898	Local.	Yes.	.....	.....	Cured.	.....	No.	March, 6, 1899, intense anæmia	.....	.....	.....	.....	.....	.....	.....	.....	Result of operation perfect until death.
13	J. S.	47	Partial; 75 : 80; catheter once at night.	Yes.	Yes.	Cystitis.	Lateral lobes equally enlarged; post-prostatic pouch well marked.	Two { Nov. 11, 1898 / Dec. 13, 1899	Local. "	Yes.	.....	.....	Cured.	Nov. 27, 1899, cured; r. u. 10 c.c.	.....	.....	No.	4–5 × per day, nights twice.	Good.	No.	.....	.....	.....	.....	
														March, April, 1900, improved; r. u. 500 : 250.	.....	.....	No.	5–6 × per day, nights once.	Good.	No.	No; urine clear.	Considerable.	Normal.	Not noted.	At first operation posterior incision only with full strength of current, batterry giving out. Cystoscopy, Oct. 30, 1902, points to median division of median lobe, which probably acts like a valve.
														Mar., April, 1903, partial recurrence, clinically; r. u. 200 : 450	Yes.	.....	No.	5–6 × per day, n. once or twice.	Weak.	No.	"	Yes.	Normal.	Yes.	
14	H. J.	71	Total for 7 years; catheterization difficult.	Not noted.	Yes, hard	Cystitis; diabetic for last fifteen years.	Large median lobe; sacculated bladder.	Three { Jan. 25, 1899 / Feb. 21, " / April 4, "	Local. " "	Yes.	.....	.....	Improved.	March, April, 1900, improved; r. u. 150 : 500.	.....	.....	Yes; twice in 24 hrs.	4 × in 24 hours.	Weak.	No.	Yes.	Marked.	Normal.	.....	Prostatectomy would have been preferable to Bottini's operation.
														March, April, 1903, slightly benefited only; voluntary micturition a few drops; otherwise total retention.	Yes.	.....	Yes; 3 × in 24 hs. catheterization.	.....	.....	Some in glans.	Yes.	The same	Normal.		
15	J. H.	78	Partial; 35 : 25	Not noted.	Yes, compressible.	Cystitis.	Large median lobe, right lateral larger than left.	One, Feb. 11, 1899	Local.	Yes.	.....	.....	Much improved.	March, April, 1900, much improved; r. u. 55 : 80.	.....	.....	No.	5–6 × per day, nights 4–5 ×	Bet. than bef. oper.	No.	Slight.	Yes.	Normal.	.....	Second operation advised in 1899; refused because patient is entirely satisfied with his present condition.
														March, April, 1903, much improved; r. u. 110 : 125.	Yes.	.....	No.	" "	Moderate	No.	"	The same	Irregular.	Yes; erection present.	
16	M. M.	58	Total.	Not noted.	Yes, soft.	Chronic cystitis; nephritis.	No median lobe.	One, Jan. 6, 1899	Local.	Yes.	.....	Peforation of membranous urethra; perineal abscess.	Cured.	Mar., April, 1900, cured; r. u. 115 : 35.	No.	1901, cholecystitis and peritonitis.	No.	8–10 × per day, nights 7–8 ×	Satisfactory.	No.	Yes.	Yes.	Normal.	No erection for last five years.	Reported as "cured" in 1900; evidently a mistake. Perineal wound remained closed.
17	H. U.	79	Total.	Not noted.	Yes, soft.	Cystitis; chronic pyelonephritis; vesical stone.	Large median lobe; dark, yellowish spot in fundus not recognized as stone; continuous bleeding from prostate.	One, Mar. 31, 1899	General.	No.	6 days after operation suppurat. in cavum Retzii, due to anterior cut.	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Anterior cut as a routine measure has been abandoned since this experience.
18	X. Y.	58	Partial; catheter.	Not noted.	Yes.	Four small vesical stones; evacuated by suction.	Two lateral shallow incisions, horizontal direction, visible. (Bottini's operation had been done in April, 1898, by another surgeon.)	One, April 20, 1899	General.	Yes.	.....	Perforation of urethra; perineal abscess.	Much improved.	March, April, 1900, l.; much improved; r. u. varying.	.....	.....	No.	Not stated.	.....	No.	Slight.	Considerable.	Normal.	Not noted.	
														March, April, 1903, l. improved.	Yes.	....	Yes; once or twice for convenience's sake.	Varies according to weather every 2–9 hours, once during night.	Weak.	No.	"	.....	Normal.	Yes.	
19	S. H.	74	Total.	Not noted.	Yes, medium consist-	Cystitis; pyelonephritis.	Body of gland projects into viscus.	Preliminary bilateral vasectomy May 12, 1899.	....	.....	.....	Suppurative funiculitis; abscess opened at site of ligation of	Much improved.	March, April, 1900, much improved. r. u. 75 : 225.	No.	1902 cause not known.	No.	3 × per day, nights 2–3 ×	Strong.	No.	Yes; marked	Considerable.	Normal.	Not noted.	

21	C. B.	49	Partial.	Yes.	Yes.	Persistent suprapubic fistula following suprapubic lithotomy one year before.	No median lobe.	One, Oct. 11, 1899	Local.	Yes.	.....	.....	Cured.	March, April, 1900, cured. r. u. 150 : 120. Mar., April, 1903, cured ; r. u. 200 : 40.	.....	.....	No.	5–6 × per day, nights not at all.	Good.	No.	No.	Considerable.	Normal.	Lost erection since operat'n ; has emissions.	Suprapubic fistula has remained closed.
															Yes.	.....	No.	4 × per day, nights not at all.	Good.	No.	No.	The same	Normal.		
22	X. Y.	72	Total.	Not noted.	Yes, soft.	Cystitis ; chronic nephritis.	No median lobe.	One, Oct. 18, 1899	Local.	No.	Phlebitis of left saphenous vein, followed by embolic (?) pneumonia 11th day after operation.	.....	Spontaneous urination from time of operation.	....	.....	.....	.....	....	.....	.....	.....	.....	.....	.....	Death indirectly due to operation.
23	M. K.	72	Partial ; catheter.	Not noted.	Yes.	Cystitis ; pyelonephritis.	Omitted.	Two { Oct. 9, 1899 / Oct. 19, "	Local. "	Yes.	.....	.....	Much improved.	March, April, 1900, l. much improved.	No.	1901, cancer of axillary glands following epithelioma of finger.	No.	3–4 × per day, nights twice.	Strong.	No.	.....	Considerable.	Improved	.....	
24	L. Z.	62	Total.	Not noted.	Yes, medium consistency.	Slight cystitis.	Omitted.	One, Jan. 13, 1900	Local.	Yes.	.....	.....	Cured.	Mar., April, 1900, cured ; refused test.	.....	.....	No.	4–5 × per day, nights once.	Excellent.	No.	No.	Considerable.	Normal.	Yes.	
														Mar., April, 1903, l. much improved.	Yes.	.....	No.	5 × per day, nights once.	Good.	No.	No.	Gained.	Normal.	Yes.	Fistula permanently closed.
25	R. D.	48	Partial ; catheter.	Yes.	Yes, soft.	Vesical stone. March 13, 1900, litholapaxy followed by absolute retention.	No median lobe.	One, April 4, 1900	Local.	Yes.	.....	Bilateral epididymitis	Cured.	March, April, 1903, cured ; r. u. 75 : 15.	Yes.	....	No.	3–4 × per day, nights not at all.	Good.	No.	No.	Yes.	Normal.	Yes.	
26	L. H.	56	.....	Yes.	Yes.	Vesical stone. March 6, 1900, litholapaxy followed by complete retention ; multiple peripheric neuritis. Mar. 31, suprapubic cystotomy ; persistent suprapubic fistula.	Omitted.	Two { May 12, 1900 / July 13, "	Local. "	Yes.	.....	....	Cured.	March, April, 1903, l. improved.	Yes.	.....	No.	10–12 × per day, nights 5–6 ×	Fair.	No.	.....	Yes.	Normal.	Yes.	
27	S. C.	70	Total.	Not noted.	Yes.	Cystitis ; chronic nephritis.	No median lobe.	One, May 4, 1900	Local.	Yes.	.....	.....	Improved.	March, April, 1903, improved ; r. u. 40 : 60.	Yes.	.....	No.	3–4 × per day, nights once.	Good.	Some.	Slight.	Yes.	Slight constipation.	No inclination for last 12–15 years.	
28	A. H.	64	Partial ; catheter.	Not noted.	Yes.	Cystitis ; chronic pyelonephritis.	Frustrated by hemorrhage.	June, 1898, bilateral vasectomy by another surgeon ; no improvement.	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	
								Two { May 30, 1900, permanent catheter 34 dys. July 26, 1900	General. "	Yes. Yes.	.....	.....	Improved.	....	No.	1902, pyelonephritis, l.	.....	.....						
29	X. Y.	67	Partial ; catheter 6 × in 24 hours.	Not noted.	Yes, soft.	Cystitis with alkaline fermentation ; chronic nephritis ; suprapubic cystotomy with removal of median prostatic lobe, 1899, by another surgeon.	Yes ; no stone.	One, June 1, 1900	General.	Yes.	.....	Suppurative orchitis, left side, seven weeks after operation incised and drained ; two mos. later right epididymitis.	Improved.	....	No.	Post-operative mania following suprapubic cystotomy for rapidly growing phosphatic stone, April 29, 1901.	.....	.....	.....	.....	.....	.....	.....	July 20, 1900, condition splendid ; passed 4 to 8 ounces at one time, at intervals of three to four hours.
30	N. L.	70	Total.	Not noted.	Yes, compressible.	Cystitis.	Omitted.	One, June 14, 1900	Local.	Yes.	.....	Four weeks after operation slight right epididymitis ; subacute perineal abscess ; incised July 11.	Cured.	April, 1903, cured ; r. u. 175 : 25.	Yes.	.....	No.	4 × per day, once or twice at night.	Good.	No.	Slight.	Considerable.	Normal.	Yes.	
31	H. H. H.	60	Partial ; 50 : 700 ; catheter used occasionally.	Not noted.	Yes, soft.	Cystitis ; chronic pyelonephritis ; frequent hæmaturia ; extremely painful urination.	Omitted.	One, July 7, 1900	Local and suggestive general anæsthesia, with alcohol and water.	Yes.	.....	.....	Improved.	Jan , 1901, r. u. 50 : 450 ; pyelonephritis much improved according to urinary analysis ; hæmaturia ceased entirely since operation ; urination painless ; back to business ; enjoys life.	No.	Fall, 1902, pyelonephritis.	.....	.....	.....	.....	.....	.....	.....	.....	Patient had refused second Bottini operation. Case proves what Bottini's operation can still accomplish in seemingly hopeless cases. Postoperative permanent catheterization, 19 days, well borne.
32	H. S.	71	Total.	Not noted.	Yes, soft.	Cystitis ; quiescent nephritis.	Omitted.	One, July 28, 1900	Local and suggestive gen. with alcohol and water.	Yes.	.....	.....	Cured.	.....	No.	1902, cause not known.	.....	.....	.....	.....	.....	.....	.....	.....	Patient got rid of catheter and considered trouble cured up to time of death. (Communication from patient's son.)
33	H. R.	57	Partial ; 125 : 285	Yes.	Yes, medium consistency.	Slight cystitis.	No median lobe, body bulging into bladder.	One, July 12, 1900	General.	Yes.	.....	Perineal abscess, incised three days later.	Cured.	April, 1903, cured.	Yes.	.....	No.	.....	Good.	No.	.....	Yes.	Normal.	Yes.	Firm bugging of prostate evident cause of urethral perforation ; firm compression of gland abandoned after this experience.
34	H. C.	66	Total.	No.	Yes.	Cystitis ; pyelonephritis. Previously frequent chills and long-continued fever ; amount of urea 6 grammes in 24 hours.	Small median lobe ; no stone ; unsatisfactory on account of hemorrhage.	One, Oct. 10, 1900	Local.	No.	Oct. 25, 1900 embolic(?), pneumonia	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Would have been wiser to refuse operation in view of complicating kidney affection ; however, patient insisted upon relief at all hazards.
35	X. Y.	75	.....	Not noted.	Yes.	Chronic cystitis ; marked pyelonephritis ; persistent suprapubic fistula after lithotomy done 1890 by another surgeon ; 1894, unilateral (left) castration ; recto-urethral fistula following Bottini's operation done twice 18 and 19 months before by another surgeon.	Omitted.	One, Nov. 27, 1900	Spinal.	Yes.	.....	Right epididymitis ; infiltration of remnant of left cord.	Improved.	Feb. 4, 1901, patient writes : "fistula is becoming so tight that I have difficulty in introducing catheter ; there is not a particle of leakage."	No.	1902, after unsuccessful operation, attempt at closing recto-urethral fistula by surgeon at his home.	.....	.....	.....	.....	.....	.....	.....	.....	
36	J. S.	58	.....	Not noted.	Yes.	Cystitis ; persistent suprapubic fistula following lithotomy done by me in May, 1898, 55 faceted stones being removed ; large prostate with pronounced median lobe not interfered with.	Four faceted stones in bladder.	One, Nov. 11, 1900, litholapaxy plus Bottini's operation at same sitting.	Spinal.	Yes.	.....	Bilateral epididymitis.	Cured.	April 29, 1901, improved. April, 1903, 1 fistula reopened Nov., 1902, probably in consequence of new vesical stones	Yes.	.....	No.	4–5 × per day, nights once.	Fair.	No.	Slight.	Yes.	.....	.....	Suprapubic fistula closed on tenth day after operation.
37	J. G. F.	73	Partial ; 25 : 250	Yes.	Yes, soft.	Cystitis ; chronic nephritis.	.....	One, Dec. 12, 1900	Spinal.	Yes.	.....	.....	Improved.	March 27, 1901, r. u. 150 : 50. April, 1903, not directly heard from.	.....	.....	No.	4 × per day, once at night.	Fair.	No.	Slight.	Yes.	Normal.	.....	
38	H. G.	60	Partial.	Not noted.	Yes.	Chronic cystitis ; suprapubic lithotomy April, 1893, by author ; calculus.	At first omitted on account of previous prolonged attacks of urethral fever. March 19,	{ Jan. 24, 1901, Bottini. April 1, 1901,	General. "	..... Yes.	.....	.....	Improved.	March 3, 1901, vesical irritation much reduced ; r. u. varying ; chip of calculus found in eye of catheter	Yes.	.....	No.	4 × per day, once at night.	Fair.	No.	Slight.	Yes.	Normal.	.....	

39	M. E.	52	Partial; 90 : 180; catheter twice per day.	Not noted.	Yes.	Cystitis.	Small median lobe.	One, Feb. 15, 1901	Spinal.	Yes.			Improved.	r. u. 200 : 1000.	Yes.		Yes; once at night.	7–8 × per day, nights not at all.	Fair.	Slight at times before urination.	Marked.	Yes.	Normal.	Yes, until pat. had double cystrat'n perf'med in 1902 by another surgeon on account of painful erect'n.	200 c.c. boric acid solution injected, he afterward passed 150 c.c. in a continuous strong stream.
40	F. T. B.	58	Total; catheter twice in 24 hrs.	No.	No.	Cystitis.	Diverticul. in left part of fundus; slight median lobe, body bulging into fundus.	One, Apr. 20, 1901	General.	Yes.			Improved.	March, April, 1903, improved.	Yes.										
41	N. Y.	71	Partial.	Not noted.	Yes.	Cystitis; chronic nephritis.	Large intravesical prostate; no median lobe; large stone.	One, Apr. 24, 1901, litholapaxy plus Bottini.	Spinal.	Yes.			Improved.	March, April, 1903, improved; r. u. varying on account of presence of small calculus; bladder has not been tested since operation.	Yes.		No.	5–6 × per day, 2–3 nights.	Fair.	No.	Slight.	Yes.	Normal.	Yes.	Feels so well that he has thus far refused evacuation of small calculus.
42	J. W.	67	Partial; 35 : 25	Not noted.	No.		Intravesical enlargement evident; no median lobe.	One, June 8, 1901	Spinal.	Yes.			Improved.	March, April, 1903, not heard from.											
43	J. M.	71	Partial.	Not noted.	Yes.	Cystitis; chronic nephritis.	Large median lobe.	One, June 18, 1901	Spinal.	Yes.			Improved.	April, 1903, improved; refuses catheterization.	Yes.		No.	3 × per day, night once.	Weak.	No.	Yes.	Yes.	Normal.	Not known.	No treatment since operation; feels perfectly well; considers himself cured.
44	W. B.	69		Not noted.	Yes, hard.	Cystitis; persistent suprapubic fistula following suprapubic cystotomy and extirpation of median lobe in 1898 by another surgeon.	Body bulges into bladder; no vesical stone.	One, June 19, 1901	Spinal.	Yes.			Improved.	Summer, 1902, suprapubic fistula reopened coincident with formation of phosphatic stone; alkaline fermentation in bladder (perineal prostatectomy with removal of stone by another surgeon).	Yes.									Suprapubic fistula closed.
45	X. Y.	72	Total.	Not noted.	Yes.	Cystitis.	Omitted.	Two { July, 9, 1901 / Aug. 11, 1901	Spinal. Spinal, with tropacocaine in solution.	No.	Oct. 14, 1901, spinal anæsthesia.													
46	H. A.	58	Total.	No.	Yes, medium consistency.	Cystitis; marked pyelonephritis.	Unsatisfactory on account of bleeding.	One, July 15, 1901	Spinal.	Yes.			Improved.	March, April, 1903, l. improved.	Yes.		Yes, twice per day and irrigation of bladder.	5 × per day, nights once.	Fair.	Yes.	Yes.	Yes.	Normal.	Yes.	
47	M. M.	62	Partial; 200 : 325	Not noted.	Yes.	Tabes dorsalis; slight cystitis.	No median lobe.	One, July 17, 1901	Spinal.	Yes.			Improved.	October, 1901, improved. In 1902, on account of incomplete result, suprapubic prostatectomy by another surgeon.	Yes.		No.	5–6 × per day, nights twice.	Varying.	No.	Slight.	Yes.			
48	X. Y.	78			Yes.	Persistent suprapubic fistula following cystotomy done by me July 20, 1901, for urinary infiltration of cavum Retzii.	Omitted.	One, Oct. 25, 1901	Spinal.	No.	Oct. 26, 1901, spin. anæs. apoplexy.													
49	M. K.	62	Partial and total alternating 50:50; catheter.	No.	Yes, medium consistency.	Slight cystitis.	Large intravesical tumor.	One, Nov. 29, 1901	Local.	Yes.			Cured.	March, April, 1903, cured; r. u. 35 : 15; patient had just urinated before; 240 c.c. injected into bladder and 240 c.c. passed.	Yes.		No.	3–4 × per day, nights once.	Fair.	No.	No.	Yes.	Normal.	Reduc'd power before operation; worse since.	
50	A. D. W.	69	Partial; 60 : 500 c.c. catheter once in 24 hours.	Yes.	Yes, hard.	Cystitis; April, 1900, resection of vas deferens by another surgeon.		One, Dec. 18, 1901	Local.	Yes.		Unilateral epididymitis.	Improved.	March, April, 1903, improved. r. u. 200 : 225.	Yes.		No.	4 × per day, nights 2–3 ×	Good.	No.	Slight.	Yes.	Perfect.	Yes.	
51	F. L.		Partial.	Not noted.	Yes, slightly.	Cystitis; pyelonephritis.	Median lobe of medium size; body bulging into bladder.	One, April 12, 1902. June 9, 1902, nephrotomy for large pyonephrosis.	Local.	Yes.		Small recto-urethral fistula on eleventh day after operation.			No.	Bilateral pyonephrosis.								Patient absolutely refused cutting operation. The only case in which the street current with transformer, without ampere meter, was used.
52	H. S.	70	Partial; catheter.	Not noted.	Yes.	Litholapaxy twice, in Vienna and Paris; cystitis; vesical stone.	Median lobe; one large and two small stones.	Two { June 19, 1902, litholapaxy plus Bottini did not have bladder tested as advised; recurrence of stone). / March 24, 1903, litholapaxy plus Bottini.	General. / General.	Yes.			Improved. / Improved.	May 27, 1903, improved; r. u. 100; few drops.	Yes.		No.	Varying.	Fair.	Little.	Yes.	Yes.		Yes; but has had no inclination for last five years.	
53	J. S.	80	Total.	Not noted.	Yes.	Cystitis; paralysis agitans.	Omitted.	One, May 19, 1902	Local.	Yes.			Improved.		Yes.		No.								
54	L. [illegible]	70	[illegible]	Yes.	[illegible]	[illegible]	No median lobe; much bulging of body.	One, July 9, 1902	Local.	Yes.			Improved.	March, April, 1903, improved; r. u. 150 : 180.	Yes.		No.	2 × per day, nights 2–3	Strong.	Slight, on and off.	No.	Yes.	Sl. constipated.	Yes; no ejaculation.	
55	J. S.	52	Partial; 15 : 410	Not noted.	No.	Cystitis.	Large body of gland; median lobe. (?)	One, June 20, 1902	Local.	Yes.		July 18, acute orchitis, and epididymitis; July 23, orchidectomy (gangrene).	Cured.	March, April, 1903, cured; r. u. 250 : 5–10 drops.	Yes.		No.	3–4 × per day, nights once or twice.	Strong.	No.	Slight.	Considerable.	Normal.	Yes.	
56	M. F.	[illegible]	[illegible]	Not noted.	No.	Cystitis.	No median lobe; large intravesical tumor.	One, Nov. 4, 1902	Local.	Yes.			Cured.	March, April, 1903, cured; r. u. 100 : few drops.	Yes.		No.	4 × per day, nights once or twice.	Good.	No.	No.	Yes.	Normal.	Yes.	Irrigation of bladder by family physician for six weeks after operation.
57	J. S.	65	Total.	No.	Yes.	Cystitis.	No median lobe; marked bulging of body.	One, Dec. 23, 1902	Local.	Yes.			Cured.	March, April, 1903, l. cured.	Yes.		No.	3–4 × per day, nights once or twice.	Very good.	No.	No.	Yes.	Slightly constipated.	Had lost power some time before operation.	Patient as well as wife absolutely opposed to cutting operation.
58	S. M.	71	Total.	Not noted.	Yes.	Cystitis.	Slight median lobe; bulging of body.	One, Feb. 2, 1903	Local.	Yes.			Improved.	May 5, 1903, r. u. 60 : 225 c.c.	Yes.		No.	" " "	Fair.	No.	Yes.	Considerable.	Normal.	No erection since 4 years.	
59	L. W.	66	Partial; [illegible]	No.	Yes, medium consistency.	Pronounced mitral murmur.	Median lobe.	One, Mar. 26, 1903	Local.	Yes.		Bilateral epididymitis eight weeks later.	Improved.		Yes.									No erection for last 2 years.	

[1] R. U. = residual urine.

[2] Wherever figures are divided by a colon, the one before the colon indicates the number of c.c. voluntarily passed by the patient; the one after the colon the residual urine

[3] As cystoscopy naturally showed a trabecular bladder in every one of these patients, since otherwise the diagnosis of "enlarged prostate" in cases of a missing rectal tumor could not have been made, mention of this fact will not be made again.

[4] Whenever general anæsthesia was given, this was done at the special request of the patient.

[5] As to this question, undoubtedly of scientific interest, in the majority of cases circumstances prevented me from asking it at the first examination, and later it was forgotten.

[6] l. stands for written communication (letter).

[7] With exception of Case 56 none of my patients had any after-treatment, although it was advised in every instance.

done, and if all the details of the operation be carried out properly, the result in trained hands is often surprisingly good.

The proper carrying out of Bottini's operation, then, has to be looked upon as a difficult procedure, involving considerable experience.

My purpose in writing this paper is not to discuss the generally recognized value of the two excellent cutting operations at our disposal for prostatic enlargement, viz., suprapubic and perineal prostatectomy, but to prove from my own personal experience, that in certain specially selected cases, where prostatectomy by either route is contraindicated or refused by the patient or his relatives, Bottini's operation should be proposed, inasmuch as it, too, may not only relieve, but completely cure the prostatic trouble.

In order to personally test the merits and demerits of galvanocaustic prostatotomy, I made it a point for five years, from October, 1897, to October, 1902, to practise Bottini's operation to the exclusion of others. No selection of cases was made. Regardless of statistics, the operation was done in every case of prostatic hypertrophy that came under my care.[1] Age, debilitated condition, complicating renal affection, were not considered contraindications. In not a single instance was the operation refused as long as the patient asked for it. In every one of the cases the after-treatment was carried out by me personally; points of interest in the further history were carefully noted. It stands to reason that, by thus making no discrimination whatever, Bottini's operation was, in some instances, performed upon patients who, according to my present views, would have derived greater benefit from prostatectomy.

As regards the death rate, this, too, was naturally swelled by my not refusing the operation to men whose far-advanced bilateral complicating renal affection should have deterred me from making any attempt at still bringing relief. Further, I commenced this work "a pioneer," in the real sense of the word, having no other guide in the beginning than Bottini's original writings and Freudenberg's first brief but excellent article, published in the *Berliner klinische*

[1] The only exception I made was in a man with a suppurating enlarged gland; here extirpation, of course by the perineal route, was performed.

Wochenschrift in April, 1897. The instruments and batteries I first used were inferior to those now employed. The decrease in the death rate of the consecutive series (of 12 each) of my cases nicely illustrates the gradual improvement in the necessary paraphernalia as well as technique and personal dexterity.

A step backward with regard to the death rate was made at the time I did Bottini's operation with the help of spinal anæsthesia, from October, 1900, to October, 1901, and was testing solutions of tropacocaine, sterilized in various manners. Two deaths, I think, were due to this method of anæsthetizing the patient, surely not to the operation as such.[1]

Within the five years mentioned 59 patients were operated upon by me, their age ranging from forty-seven years to eighty years. Of these patients the operation was done once in 48, twice in 10, and three times in 1 patient (in all 71 operations). Fifty-two recovered and 7 died, death occurring as a direct consequence of operation in 3:

1. Acute sepsis, thirty hours after operation (Case 3), a chronic septic, on account of bilateral far-advanced pyelonephritis (author, *New York Medical Record*, March 5, 1898, p. 331). No autopsy.

2. Perforation of the bladder by anterior cut (Case 17: suppuration of cavum Retzii). Post-mortem obtained. The anterior cut has since been abandoned as a routine measure (author, *New York Medical Record*, May 12, 1900, p. 799).

3. Embolic (?) pneumonia (Case 34: advanced bilateral pyelonephritis).

Indirectly, death was due to the operation in 2 cases:

1. Suprapubic cystotomy eight days after operation (Case 9, author, *New York Medical Record*, January 14, 1899, p. 42).

2. Phlebitis of the left saphenous vein with following, probably embolic, pneumonia on the eleventh day after operation. No autopsy. (Case 22, author, *New York Medical Record*, May 12, 1900, p. 805.)

[1] I found incidentally that mixing unsterilized tropacocaine crystals with sterilized water (or the outflowing serospinal fluid), Centralblatt f. Chir., 1903, p. 314, is the safest way of preparing the drug for use.

In order not to appear biased, I shall count Case 9 among the deaths directly due to the operation, thus raising the number of deaths directly due to the operation to 4.

The remaining 2 of the 7 fatal cases died from the immediate effects of spinal anæsthesia with the sterilized solution of tropacocaine (Cases 45 and 48). The histories of these cases will be published in the near future.

Dividing my cases into series of 12 each and comparing the death rate in an ascending scale, we have:

	Deaths directly due to operation.	Deaths indirectly due to operation.
In the first 12	2	—
" second 12	1	1
" third 12	1	—
" fourth 12	—	— [1]
" fifth (11 only so far)	—	—

Of the 52 patients who recovered from operation, 34 are alive to-day; 3 could not be traced (Cases 1, 4, 42); 3 died, within six to ten weeks after operation, of pyelonephritis that had existed long before operation (Cases 2, 8, 51); 12 died from various causes, as apoplexy, cancer, general debility, nephritis, etc., from nine months to three years after the operation (Cases 7, 10, 11, 12, 16, 19, 23, 28, 29, 31, 32, 35).

Of these 52 cases, 13 had complete retention (Cases 14, 16, 19, 24, 27, 30, 32, 40, 46, 53, 56, 57, 58); 33 had incomplete retention (Cases 1, 2, 4, 5, 6, 7, 10, 11, 12, 13, 15, 18, 20, 23, 25, 28, 29, 31, 33, 37, 38, 39, 41, 42, 43, 47, 49, 50, 51, 52, 54, 55, 59); and 6 had a persistent suprapubic fistula (Cases 8, 21, 26, 35, 36, 44).

Of the 33 patients with incomplete retention, 14 used the catheter from one to six times a day (Cases 1, 4, 5, 11, 13, 18, 20, 23, 25, 28, 29, 49, 50, 52); 1 wore a urinal (Case 10).

Of these 27 patients who had been using the catheter—viz., 13 with complete and 14 with incomplete retention—18 got rid of the catheter permanently; 2 used it, mostly for convenience's sake, once at night; 3 were still obliged to use it; of 4 the later condition could

[1] Two deaths due to spinal anæsthesia.

not be ascertained. The patient who had worn the urinal put it aside soon after the operation.

Of the 6 patients with persistent suprapubic fistula, 2 (Cases 21, 26) have remained permanently cured to date, fistula remaining closed two and three-quarters years and three and one-half years, respectively, after operation; in 2 (Cases 36, 44) the fistula closed temporarily, but broke open again one year and two and one-half years, respectively, later, coincident with the formation of a new stone; 1 died, after Bottini's operation performed by me (twice before by another surgeon), with a contracting fistula ten weeks after operation, of pyelonephritis which had existed prior to my operating (Case 8); 1, in whom the suprapubic fistula had persisted for ten years, was so much improved by the operation that one year later (last written communication) he complained about his inability to introduce a No. 8 French silver catheter through the fistula for the sake of irrigation, as he had been in the habit of doing for so many years. He died two and one-half years later, after an attempt made by a surgeon at his home to close a recto-urethral fistula, brought about by the colleague who had done Bottini's operation twice before he came into my hands (Case 35).

In 9 of the 52 patients with hypertrophy of the prostrate treated by means of Bottini's operation I found the trouble associated with stone. In these the presence of the stone was not determined before operation in 1 case (Case 17, author, *New York Medical Record*, May 12, 1900, p. 799).

The stone was washed out before doing Bottini's operation in 1 case (Case 18, *New York Medical Record*, May 12, 1900, p. 801).

The stone was cut out by means of suprapubic cystotomy in one case (Case 21, ibid., p. 804). Persistent suprapubic fistula followed; permanently closed by means of Bottini's operation (see above and *New York Medical Record*, May 12, p. 801).

The stone was removed by litholapaxy in one case, which was followed by irritated bladder, necessitating suprapubic cystotomy; persistent fistula set in, which was then permanently cured by Bottini's operation (Case 26).

The stone was removed by litholapaxy in one case, followed by

Bottini's operation three weeks later to quiet the irritated gland; completely cured (Case 25). The stone was removed by litholapaxy plus Bottini's operation at the same sitting in 4 cases.

Three of the last 4 cases were described in detail in my article entitled "The Treatment of Prostatic Hypertrophy Associated with Stone in the Bladder by Means of Litholapaxy and Bottini's Operation at One Sitting" (*Annals of Surgery*, July, 1902).

In 5 of the 52 cases the membranous urethra was accidentally injured, causing perineal abscess in 4 (Cases 16, 18, 30, 33), chronic inflammatory œdema of the scrotum and penis in 1 (Case 20). These 4 patients, in every single instance, had a very soft gland, and every time the prostate had been well hugged by the beak of the incisor, as originally advised by Freudenberg and described in my last article. Furthermore, I did not at that time use an incisor with centimetre division on the shank. This scale on the shank (recent proposition of Freudenberg[1]) I consider a very important point indeed. Just as the needle of the ampèremeter of the battery indicates the degree of heat of the invisible galvanocaustic knife as it ploughs its way through the obstructing mass, so these marks on the shank will show us whether or not the beak is still within the bladder. By this means we are enabled to control its proper apposition to the body of the gland. This scale on the shank is particularly indispensable in those cases—not infrequently met with—where the palpating finger fails to feel a rectal tumor, although the cystoscope shows the presence of intravesical enlargement. If we do not hug the gland too much by forcibly pulling the instrument forward, the beak will stay in place and not slip into the prostatic urethra. These five perforations, followed by formation of a perineal abscess and inflammatory œdema, happened in my first 33 cases, the last time in Case 33, and had occurred entirely without my knowledge. Since that time I have taken care to avoid compressing the gland, and the accident has not occurred again. I now try to walk the golden middle way. I hug the gland, pull gently, but do not compress it. It may be mentioned here, however, that all my patients in whom the accident happened

[1] Centralblatt für Harn. u. Sexual Organe, 1901, p. 303.

recovered. One (Case 16), classed as improved, died, two years later, of acute cholecystitis and peritonitis, remaining improved, as far as his former trouble was concerned, until death; one (Case 18) is alive and remains improved to date; two others (Cases 30 and 33) were cured and remain so up to date; the patient with inflammatory œdema (Case 20) is alive to-day (classed above as not improved; large hard gland, etc.).

My personal experience with these cases does not, therefore, bear out the statement recently made by E. L. Keyes, Jr., who says in his valuable article on Bottini's operation[1] that all the cases in which this accident happened had died. On the other hand, one thing is certain, namely, that this mishap—regrettable as it is at the time as well as annoying to both patient and surgeon—gives assurance that the division of the gland has been done thoroughly, provided the beak of the incisor stayed in its place.

In one patient (Case 51) the rectum was injured and a recto-urethral fistula established. The accident occurred in a much reduced man, aged seventy-one years, who had a small, soft prostate and far-advanced suppurating bilateral pyelonephritis. In his case (the only time in the 71 operations done), for special reasons, the street current, without ampèremeter, was used. The fistula never gave the patient much trouble, except that the often occurring bubbling caused by gas passing from the rectum into the membranous urethra at the site of communication annoyed him. He recovered from the effects of Bottini's operation. In course of the after-treatment bilateral nephrotomy with drainage had to be done at various times, at either side large abscesses being evacuated, both kidneys having been entirely destroyed by the suppurating process. Death occurred eight weeks after operation. In this case it would have been better to have left the patient to his fate; but his complaint of continued, intolerable, burning pain at the neck of the bladder induced me to still make an attempt at relieving him.

Marked unilateral or bilateral epididymitis, as a direct sequel to Bottini's operation, was seen in 6 cases (Cases 25, 35, 36, 50, 55, 59), and suppurating process of the testicle necessitating incision in

[1] Philadelphia Medical Journal, December 6, 1902.

2 cases (Cases 4, 29); necessitating castration in 1 case (Case 55); a unilateral suppurating process of the vas deferens after vasectomy in 1 case (Case 19).

A distinct cause for these complications cannot be stated; they were observed in cases in which the permanent catheter was left in place for some time as well as in those where this was not done. Patients in whom the permanent catheter was left *in situ* for more than four weeks did not develop this inflammation. It was also seen by other surgeons after prostatectomy with or without catheterization and bladder irrigation, with or without sounding during the after-treatment. Other sequelæ of Bottini's operation, such as sepsis, pyæmia, and embolic pneumonia, I have not seen any more of late. Why not, I am unable to say. Many patients operated upon were surely in a deplorable general condition.

Another much dreaded sequel, perforation of the bladder, can be avoided by exercising proper care in operating, omitting the anterior incision and filling the bladder with fluid or air.

In 20 of the 52 cases that recovered the stream is noted as good at time of first examination; in 14 as fair; in 2 as weak; 32 had no pain in urinating; 5 had some pain in urinating; and 1 had much pain in urinating.

This became changed in a few instances at later examinations, as may be seen from the table.

As regards weight, this was noted in 38 of the surviving cases, and in every instance there was a gain, sometimes considerable.

I have also observed in some cases that, even though the urinary trouble was not much relieved by the operation, the general condition of the patients becomes improved. Pre-existing constipation was incidentally overcome in the majority of cases.

With reference to curing the vesical catarrh, I have so far not seen a single man with sufficient patience to keep up continued irrigation of the bladder, as advised; hence, quite a number present a more or less turbid urine. On the other hand, I counted five or six patients whose urine cleared up absolutely after normal vesical drainage had once become re-established.

The results obtained in the first 24 cases operated upon by me

were tabulated and reported at length in my paper on "Bottini's Operation for the Cure of Prostatic Hypertrophy" (*Medical Record*, May 5, 1900). It will be of interest to compare the results found at that time—two and one-half years after I first did Bottini's operation—with those noted in March to April, 1903.

Conditions found March to April, 1900, showed the following: 24 cases with 30 operations—*i. e.*, 4 cases, each 2 operations, 8; 1 case with 3 operations, 3; 19 cases with 1 operation, 19. Nine were cured (Cases 4,[1] 5, 6, 7, 12, 16, 20, 21, 24), final examination three to twenty-five months after operation; 7 much improved (Cases 1, 10, 13,[2] 15, 18, 19, 23), final examination six to twenty-seven months after operation; 2 improved (Cases 11, 14), final examination twelve to nineteen months after operation; 4 died (Cases 3, 9, 17, 22) as a direct or indirect result of operation; 2 others (Cases 2, 8) died in spite of operation, six and ten weeks, respectively, after the same, of pyelonephritis of old standing.

Re-examination and correspondence with the surviving 18 of these 24 patients or their families brings out the following late results in March to April, 1903:

Of the 9 patients reported as cured in 1900, 1 was reported dead (Case 12), the end having come as a result of intense anæmia, five months after operation; urination perfect up to death. Two have died since 1900 (Case 7, of apoplexy, and Case 16, of cholecystitis and peritonitis), Case 7 having remained fully cured as to his urinary trouble up to his death in the fall, 1902, four and one-half years after operation; Case 16 had to be classed as "improved" at the time of his death. One was not heard from (Case 4).

Of the remaining 5 (Cases 5, 6, 20, 21, 24), 3 have remained absolutely cured and are in splendid condition to-day (Cases 5, 6,[3] 21). Case 21 had a persistent fistula after suprapubic lithotomy,

[1] Had not reported for examination up to the time of closing the report, April 1, 1900; on January 2, 1901, he called at my office in excellent condition.

[2] Had partial recurrence clinically later.

[3] Presented before the New York Surgical Society. See Annals of Surgery, 1902, vol. xxxvi. p. 274.

permanently closed by Bottini's operation (see above). One is in almost the same condition as before operation (Case 20); large, hard prostate with median lobe; two operations; long-continued postoperative retention. Here prostatectomy should have been done (see *Medical Record*, May 12, 1900, p. 803).[1] One has to be classed as much improved (Case 24); had absolute retention before operation; got rid of catheter; urinated in 1900 four to five times during the day and once during the night; to-day, as per written communication, four to five times during the day and six times during the night.

Of the 7 cases reported as much improved in 1900, 3 died (Cases 10 and 19, causes not known; Case 23, cancer of the axillary cavity following epithelioma of the finger). Bladder condition of Cases 10 and 19 up to the time of death could not be ascertained; Case 23 was worse than before, in part due to cachexia. One was not heard from (Case 1); 3 are living to-day (Cases 13, 15, 18). Of these 3 patients, 1 remained "much improved" (Case 15); 1 is to be classed as "improved" (Case 18), patient uses a catheter for convenience's sake twice a day; trouble recurred to some extent in one patient (Case 13).

This latter patient has no subjective trouble to-day; his urine is absolutely clear; he urinates from five to six times per day, nights twice, but the relation between voluntary micturition and residual urine is 200 : 450. Repeated cystoscopy points to a median lobe, which was divided by operation, the two halves seeming to act as a valve during urination. My advice to the patient has been suprapubic cystotomy and prostatectomy through the same route, or, in case of his refusing prostatectomy, suprapubic cystotomy for the removal of the divided median lobe, and placing the knife of the incisor in position under the guidance of my eyes. There is no prostatic enlargement palpable per rectum.

Of the 2 patients reported as "improved" in 1900, 1 died (Case

[1] This patient, reported as cured in my last article on this subject in 1900, was so classed on the strength of his own statement to that effect in a letter; had I had an opportunity at the time of examining him I should have probably classed him among the improved cases rather than the cured.

11) of pneumonia after much suffering from a chronic bone disease, incidental with increasing debility and cachexia, in 1902; a part of the urinary trouble, for which he had been operated upon by me in October, 1898, had recurred some time before death. The other patient (Case 14), a pronounced diabetic, seventy-two years of age, with a hard gland of enormous size, has, since 1902, relapsed into the same condition as prior to operation. He is the only one of my 59 patients that has been operated upon three times. At present his voluntary urination is represented by a few drops; he again depends upon the catheter, which he uses three to four times in twenty-four hours. The only tangible benefit derived from the operations done between January and April, 1899, is the temporary relief he has had for a period of three years in addition to greater ease of catheterization, with reduced pain, up to the present time.

With my present experience, my choice in this case, if operation had been insisted upon, would have been perineal prostatectomy under spinal anæsthesia.

To summarize: 5 of the 9 patients reported as cured in April, 1900, are still living and have been either heard from or re-examined in 1903. Of these, 3 have remained cured; 1 has to be classed as much improved (recurrence of frequency of micturition during the night); 1 not benefited (classed as cured in 1900 on basis of written communication).

Three of the 7 patients reported as "much improved"[1] in April, 1900, are still living—either heard from or re-examined in 1903—and of these, 1 remains much improved; 1 can be classed as improved only, to-day; 1 has recurrence of residual urine, commencing before 1900.

One of the 2 patients reported as improved in April, 1900, and still living, proves on final examination to be benefited to some extent only.

An analysis of all the cases that were either re-examined or heard from in March to April, 1903 (34 in number), shows the following:

[1] I shall in future not subdivide results into "cured," "much improved," "improved," "not cured," but only distinguish "cured," "improved," "not cured."

10 to be classed as cured[1] (Cases 5, 6, 21, 25, 30, 33, 49, 55, 56, 57[2]); 18 to be classed as improved[3] (Cases 15, 18, 24, 26, 27, 37, 38, 39, 40, 41, 43, 46, 50, 52, 53, 54, 58, 59);[4] in 1 recurrence to some extent (residual urine, Case 13; see above); in 5 former symptoms recurring after temporary cure or relief, therefore, to be classed as not improved (Cases 14, 20,[5] 36,[6] 44,[7] 47.[8]

Of the 10 patients cured, to-day, 3 had complete retention (Case 30, three days; 56, two weeks; 57, three months); 7 had incomplete retention (Cases 5, 6, 21, 25, 33, 49, 55); 3 of these—viz., Cases 5, 25, 49—had to use the catheter.

Of the 18 patients classed as improved, 6 had complete retention from ten days to two and one-half years (Cases 24, 27, 40, 46, 53, 58); 12 had incomplete retention (Cases 15, 18, 26, 37, 38, 39, 41, 43, 50, 52, 54, 59), 3 using the catheter.

Of the 15 patients who had to use the catheter, 10 laid the same permanently aside. Of the remaining 5, 2 (Cases 18, 46) use the same once or twice per day for the sake of having a longer interval of comfort, especially a better night's rest; 3 still need it, as per written communication.

To repeat: Of 15 patients that had been obliged to use the cath-

[1] If a patient who considers himself cured, got rid of his catheter, urinates without pain, has a fair or good stream, two to five times during the day and not oftener than once or twice during the night, has no vesical catarrh, or just a trace of it, and if the residual urine does not exceed 60 c.c. = 2 ounces, I call this, with others, a cure.

[2] Cases 56 and 57 need re-examination, having been operated upon in November and December, respectively, 1902.

[3] Of these, Cases 38, 41, 52, 53, and 58 were benefited by the operation to such an extent that according to former classification they would have been called much improved.

[4] Case 58 is in excellent condition at present and considers himself cured, but is too recent to be classed as cured.

[5] Both cases 14 and 20 had a hard, very large prostate. One of them should, according to present views, have been subjected to prostatectomy.

[6] Persistent suprapubic fistula after suprapubic cystotomy in 1898 (55 stones removed), litholapaxy plus Bottini in 1900 on account of recurring stones; fistula closed and urination satisfactory for two years; five months ago suprapubic fistula reopened, most probably owing to recurrence of calculosis. Patient not seen again so far.

[7] Persistent suprapubic fistula closed by means of Bottini's operation in 1901; development of vesical calculus (phosphate)—fistula reopened; prostatectomy by another surgeon.

[8] Tabic, temporary relief, soon increase of residual urine; suprapubic prostatectomy by another surgeon.

eter, 10 got rid of it permanently; 2 could, if necessary, get along without its aid; 3 are still in need of it.

In 7 of the 34 patients the prostatic trouble was complicated with vesical calculus (Cases 18, 21, 25, 26, 38, 41, 52). Two of these were cured of their stone as well as prostatic trouble (Cases 21, 25; see above). Five got rid of the stone and were improved, as far as their prostatic disease is concerned (Cases 18, 26, 38, 41, 52; see above). Cases 38 and 52 will probably be classed as cured after a somewhat longer period of observation.

Little or no attention has so far been paid to the question as to whether Bottini's operation or prostatectomy interfere with the power of intercourse. It is true, this question is purely a social one, but may be of quite some importance if the patient have a wife living and he be still below sixty to sixty-five years of age, sometimes even if he be older. Thus, not long ago, this question was the point of preliminary discussion raised by the much younger wife of a gentleman sixty-four years of age with complete retention. Bottini's operation was performed, voluntary micturition re-established, and the power of intercourse fortunately preserved.

Inquiry of the 34 patients still living regarding this point brought out the following facts: The cases of two of my patients cannot be utilized in this connection, inasmuch as prostatectomy was performed by other surgeons some time after Bottini's operation had been done by me. In three cases the present condition with regard to this point is not known. One patient, aged seventy-three years, had no inclination for the last fifteen years. One patient, aged eighty-two years, was sick for years with paralysis agitans. One, a diabetic, had absolute lack of erection for the last nine years. Three patients, two sixty-five years and one seventy-one years of age, have been impotent for the last three years or longer.

Deducting these 11 cases, we have 23 patients whose cases can be used with reference to the question at issue. Of these:

The power of intercourse was preserved in 20, viz., in 7 of the 10 cases classed as cured (Cases 5, 6, 25, 30, 33, 55, 56), in 12 of the 18 cases classed as improved (Cases 15, 18, 24, 26, 38, 39, 40,

41, 46, 50, 52, 54), and in 1 where the urinary trouble in part returned (Case 13).

In 1 of these (Case 39), aged fifty-two years, there is, however, no orgasm. In 1 (Case 54) there is no seminal discharge in spite of orgasm. In 1 (Case 50) power of intercourse is not interfered with, though both vasa deferentia were resected five years ago. Of course, ejaculation is missing.

The power of intercourse was more or less interfered with in 3 cases, viz., a man, aged forty-nine years, is impotent since operation; he has emissions; erection, however, is absent (Case 21). Another, aged sixty-two years, had weak erection before operation; is worse since operation (Case 49). A third, aged seventy-one years, claims to have lost the power of intercourse since operation (Cases 20).

Thus, Bottini's operation has produced impotence in 2 out of 23 cases, increased a weakness that had existed prior to operation in 1. In 2 other patients irregularities in the normal seminal discharge have appeared.

This question as to the power of intercourse should also be carefully noted when tabulating the late results of prostatectomy—perineal and suprapubic—a point which, as I have stated before, has thus far received but little attention. Loss of sexual power (erection) has certainly quite frequently been met with after enucleation of the gland.

It is not easy to explain this loss of sexual power (lack of erection) as a result of galvanocaustic prostatotomy or of prostatectomy.

Erection is a complex motor mechanism and, as such, subject to nerve influence. The impulse starts from the psychic action of the cortex of the large cerebral hemispheres or from the sensitive penile nerves. Both transmit it to the centre of erection, which is situated in the lumbar portion of the cord. From here the impulse is conveyed to the respective anatomical structures over two routes, viz., over the so-called nervi erigentes, representing the vasodilators of the arteria penis profunda, which feeds the corpora cavernosa, and, secondly, over the motor fibres for the ischiocaver-

nosus and transversus perinei profundus muscles. Both routes originate in the sacral plexus. These nerves run within the trunk of the common pudic nerve. The latter is situated so far laterally that it cannot be reached during any of the operations mentioned. A direct injury to the same as a causative factor of following impotence can, therefore, be excluded. However, a number of its branches might suffer during the operation. Injury to the ejaculatory ducts, or the operation as such, may produce a relaxation of the normal anatomical condition of the veru montanum and the prostatic urethra, both necessary to induce proper reflex action for erection.

The lack of seminal discharge as a sequel to any one of these operations is attributable to direct injury to the ejaculatory ducts or to a deviation of their course, or to a stricture of their lumen, both latter conditions resulting from the postoperative cicatrization around them. Its consequence is interference with normal ejaculation, or total sterility.

In perineal prostatectomy direct injury to the ducts can be avoided by bringing the field of operation into better view with the help of Syms' rubber retractor or Young's metal retractor, or other mechanical devices brought out for this purpose.

Rydygier's intracapsular resection of the prostate recently proposed (*Centralblatt f. Chir.*, 1902, No. 41) would enable us still more surely to avoid the ducts. However, as that part of the prostate immediately surrounding the prostatic urethra is left untouched by the same, it is questionable whether it will prove sufficiently effective. Further experience will show the range of its usefulness.

Data regarding the point in question in connection with suprapubic prostatectomy are also absolutely necessary. *A priori*, the high operation would seem to be more apt than the perineal one to produce impotence, inasmuch as it is done in the dark. Still, at one of the recent discussions on prostatic surgery a gentleman asserted that none of his prostatics operated upon suprapubically had shown loss of erection.

In Bottini's operation it may be possible to avoid injury to the

ducts by making the direction of the lateral incisions at an angle nearer ninety degrees than forty-five degrees and by making the posterior incision directly within the median line.

A careful compilation of all cases operated upon, with notes as to the late results also in regard to this point, is required in order to determine which of the methods under consideration is most apt to be followed by impotence. Surely, such knowledge would often materially influence the selection of the method of operating.

With regard to adding data of value to the question of the possible gonorrhœal origin of prostatic enlargement, so widely discussed of late, I regret that no careful record was kept by me as to this point; still, in looking over the histories of my cases I find the remark "no previous gonorrhœa" in 7 cases.

Having in the foregoing statistically stated my personal results in a series of 59 cases, I would yet like to add the following general remarks:

Nursing. In Bottini's operation the after-treatment sometimes requires a great deal of patience on the part of the patient as well as that of the attending surgeon. In many instances careful nursing of old, debilitated patients and prompt intervention in the event of suddenly arising emergencies are the main requisites in bringing a case to a successful issue. This accounts for the fact that ward patients so often prove to be more troublesome and less benefited by the operation than private patients who are under the immediate supervision of the surgeon or his permanent assistants.

Filling of the Bladder. Every one of my 71 operations, with the exception of those done on the first 5, has been carried out with the bladder filled with water. The massiveness of the eschars so often observed to be pushed off the gland prove the effectiveness of the operation as far as the cauterization is concerned.

In the next 12 or 24 cases that may come under my care it is my intention to do the operation with air distention of the viscus, and note results.

Anæsthesia. To-day all my operations are again carried out under local anæsthesia with 3 per cent. eucaine and a suggestive general anæsthesia with equal parts of alcohol and water, the latter

during the time of cutting the grooves. Since I have ceased compressing the gland with the beak of the incisor the local pain has been materially reduced. General anæsthesia is applied only upon the patient's specific desire.

Chetwood's Modification of Bottini's Operation. The modification of Bottini's operation proposed by Chetwood, of New York—median urethral section; digital exploration of the prostate and the introduction of a modified incisor through this wound, controlling the progress of the knife by rectal palpation—I have never tried. So far, I did not feel the want of the preliminary median incision. I follow the principle of carrying out such a purely intravesical operation as Bottini's operation, without adding this incision, same as we do in litholapaxy, except it becomes necessary during after-treatment (abscess formation). Furthermore, it will sometimes require an unusually long finger to successfully palpate the intravesical surface of the gland, and not infrequently such palpation must prove a technical impossibility—a fact which has been mentioned by Chetwood. Drainage of the bladder with the permanent catheter introduced the entire length of the urethra has given me satisfactory results. Besides, the suggested modification requires general anæsthesia and will often keep patients in bed longer than Bottini's operation does.

Young's Modification of the Bottini-Freudenberg Incisor. The various-sized blades of the galvanocaustic knife proposed by Hugh H. Young, of Baltimore,[1] I have not tried as yet, but can well see their indication, based on the result of cystoscopic examination. I shall make use of it whenever indication arises.

Litholapaxy and Bottini's Operation done at the Same Sitting. In the course of this work I found that litholapaxy, hitherto almost always advised against in this class of patients, can well be done if combined with Bottini's operation at the same sitting. I recommended this combined operation in an article on the subject recently published in the *Annals of Surgery*.[2]

Indication. Since October, 1902, I have tried to individualize with regard to advising the proper operation in every case that has

[1] Bulletin of Johns Hopkins Hospital, 1902, vol. xiii. p. 36. [2] July, 1902.

come under my observation. I have done during that period perineal prostatectomy in six and Bottini's operation in four patients. I have tried to find indications for such individualization, but would not venture to formulate any definite points with regard to it so far. At present I would say that I now invariably recommend the cutting operation in patients with a large, hard gland, also in patients with a gland of medium consistency, if they seem to be able to stand the operation and general anæsthesia. If necessary, spinal anæsthesia is employed. I do so still more if a median lobe be present. I further advise prostatectomy in patients who are desirous of being relieved of their trouble in one sitting at all hazards. If the gland be soft and compressible, particularly if not palpable per rectum, but the cystoscope has determined the correct diagnosis, if the patient be old and much run down by prolonged sickness, I advise Bottini's operation, making the patient or his relatives fully aware of what they may expect. At present it seems to me, that in cases where the condition of the patient is such as to raise doubt as to whether he will be able to stand prostatectomy, Bottini's operation, as the least risky (though not void of dangers), should be recommended. The chances are that it will do the work. However, should the result not be satisfactory, experience has shown that it does not preclude the possibility of doing prostatectomy later, at a time when such patient may have recovered from his former precarious general condition.

In other words, I carefully consider all points in every case—anatomical, pathological, and social—before I decide in favor of one of the two procedures under discussion.

A few cases for illustration:

A patient from out of town, a hard-working man, suffering from enlarged prostate associated with stone, came under my care. It was important to cure him, if possible, in one sitting. He had a very pronounced emphysema and chronic bronchitis. Perineal prostatectomy, with removal of the stone through the same incision if possible, was clearly indicated. The operation was done under spinal anæsthesia, with perfect success.

Another patient in the sixties, with complete retention for the

last three months, was brought to me on account of prostatic trouble, with the statement that he as well as his wife were absolutely opposed to any cutting operation, and the patient was willing to continue the catheter throughout the remainder of his life if nothing else could be done. Bottini's operation was proposed under these circumstances and performed soon after. About ten weeks later, upon inquiry regarding the patient's condition, he (being a German) writes: "I am famous" ("famos"), meaning that he is in excellent condition. The catheter had been laid aside.

A gentleman who had mining interests in the West, necessitating considerable travelling, wanted to have done the most radical work possible, so that no further work should be necessary. Perineal prostatectomy was proposed, accepted, and performed. At the present time, five months later, he has not a drop of residual urine; now and then some little dribbling during the night. A slight contraction of the neck of the bladder was overcome by sounding.

Another patient, above sixty years of age, had a large amount of residual urine, due to an enlarged prostate. Prostatectomy was proposed and accepted. General examination of the patient before operation revealed pronounced valvular disease of the heart, so much so that, after consultation, general as well as spinal anæsthesia seemed contraindicated. Inasmuch as Bottini's operation can be and, in fact, ought to be carried out under local anæsthesia, that operation was proposed and done, with much benefit to the patient.

Another patient still, aged eighty years, was brought to me suffering from a far-advanced paralysis agitans with contracted hip-joints and absolute retention. His widowed daughter had been taught to catheterize her father, as the people were too poor to afford a trained male attendant. After months of faithful work the daughter had broken down under the strain, and then the question came up as to what could be done for the patient. As a matter of course, I was opposed to performing even Bottini's operation upon this patient, but the relatives insisted upon more than palliative work, being willing to take any risk. Thus, in the summer of

1902, Bottini's operation was done at the hospital; a very troublesome after-treatment followed. The result was that the patient got rid of the catheter absolutely, and now has very little trouble with his urinary organs. In this case truly a great boon has been conferred upon the patient as well as his entire family by the performance of Bottini's operation. The poor old man can now at least die in peace.

Is Bottini's Operation a Radical Procedure? In conclusion, a word still with regard to our right of calling Bottini's operation a radical operative procedure. We know that it is not the bulk of the gland that causes the obstruction, but the high level of the internal urethral orifice as compared to the base of the vesical fundus. Now, if we are able to overcome this obstruction by simpler means than removal of the entire gland—viz., by establishing *permanent* gateways for the outflow of urine through the very body of the obstructing mass—such operation, I hold, must be called "radical." That this end is often accomplished has again been shown in this article. Bottini's operation, to my mind, holds the same relation to prostatectomy as litholapaxy does to lithotomy in the treatment of vesical stone, or as the clamp and cautery does to Whitehead's operation in the surgical treatment of hemorrhoids. No one doubts the efficiency of these procedures in the radical cure of the troubles mentioned. Why, then, deny Bottini's operation its just and proper place in conjunction with prostatectomy in the cure of prostatic hypertrophy?

I say, that the surgeon who undertakes the radical treatment of this disease *must* recognize the fact that we have *two* useful methods promising relief—methods that are not opposed to each other, but, on the contrary, complement each other.

The surgeon who practises one of the two operations only, will, of course, draw the line of indication for the particular operation farther than the one who practises both and individualizes, selecting that method which he thinks promises the best result. Surely, the surgeon, in order to do justice to the prostatics who entrust themselves to his care, should be able to carry out both procedures; otherwise he will either have to condemn to catheter life such

patients as are too far advanced in age or too greatly debilitated to stand the cutting operation, or "let them down easy," as an able writer recently put it in speaking of the painless death of old prostatics operated upon by means of prostatectomy.

I, for my part, do not see how we can afford to take a biased stand as regards this burning question. In my opinion it is, therefore, the duty of those unwilling to do Bottini's operation to nevertheless advise the method in cases where prostatectomy seems contraindicated.

It is my conviction that prostatectomy *and* galvanocaustic prostatotomy (Bottini's operation) will remain the two standard methods for the radical cure of the enlarged prostate gland.

Conclusions. 1. The operations making a direct attack upon the enlarged prostate gland are preferable to those aiming to exert an indirect influence.

2. We have *two* useful procedures for the direct treatment of the enlarged prostate gland—*i. e.*, prostatectomy and galvanocaustic prostatotomy (Bottini's operation).

3. In selecting the method indicated in the given case we must individualize and be guided by anatomical, pathological, and social conditions.

4. Prostatectomy is the most radical and most surgical procedure; it should be the operation of choice whenever promising success.

5. Perineal prostatectomy offers advantages over the suprapubic method, since it enables the operator to do the operation under the guidance of his eyes.

6. Debilitated patients who seem unfit subjects for the more radical operation should not be at once relegated to catheter life, nor should prostatectomy be performed in order to "let them down easy." They should be advised to have Bottini's operation done, if possible.

7. Surgeons should familiarize themselves with both methods, in order to be in a position to do justice to their patients.

8. It is the duty of those refusing to do Bottini's operation under any circumstances, nevertheless, to advise the latter in cases where

the patient asks for more radical relief and the operation with the knife seems contraindicated.

9. Further carefully compiled statistics as to the late results of both operative procedures—preferably in the hands of one man—are desirable in that they will increase our knowledge with reference to the selection of the proper method in the individual case.

DISCUSSION.

Dr. Leonard Freeman, of Denver, Col.

I have had some experience with both prostatectomy and galvano-caustic prostatotomy. The Bottini operation I have done in the neighborhood of twenty times. Some of the cases have furnished brilliant results and others miserable failures, and I have not been able to tell beforehand which result I would get. I should probably favor the Bottini operation if I could promise more beforehand, but as it is I think the operation should be reserved for, perhaps, three general classes of cases: first, cases in which we fear to give a general anæsthetic, particularly on account of the kidneys; second, cases in which the disease is in an incipient stage, and where we hesitate to propose radical prostatectomy; and, third, those cases in which the patients positively refuse prostatectomy. If we assure them that the Bottini operation may be done without making an external wound and without using a knife they will often consent, but the limitations of the operation must always be carefully explained.

Dr. A. H. Ferguson, of Chicago.

The more experience we gain with the Bottini operation its limitations become less and more clearly defined. While there is no condition of prostatic hypertrophy that cannot be treated without the electrocautery knife, still, under certain constitutional conditions it may be recommended, and even then I should limit its use to two pathological conditions of the gland, viz., constriction of the vesical orifice and a transverse bar. Let me refer to the dangers and complications of median perineal prostatectomy—my operation of choice. Injury to the membranous urethra, which we formerly avoided, is insignificant. In one case I opened the peritoneal cavity between the bladder and rectum, and although no complications followed I consider it a grave accident. Injury to the neck of the bladder is to be avoided, for loss of vesical control is thereby produced. In one case this occurred, and he has no control of his bladder beyond four ounces of urine. Opening into the rectum while operating is a preventable accident. Recto-urethral fistula occurred in two of my cases, caused by injury to the rectum, eight and twelve days, respectively, after the operation, the douché point in a careless hand being the cause in each case. They both closed. In four or five of my thirty-two cases epididymitis came on over two weeks after operation, but subsided within a few days. Perineal fistula is a sequel that has not given me much trouble; only in

one case did it last longer than four months. In this case the fistula closed and again opened several times before it permanently healed. In one case—a doctor—a stricture formed at the neck of the bladder about a month after removing his prostate, which I overcame by perineal section under cocaine anæsthesia locally used, and he has had no trouble since.

Frequent urination is the rule when the bladder is contracted by cystitis. The atonic bladder regains its power of expelling the urine. I am inclined to think that we have been removing too much prostatic tissue and not remaining satisfied with removing the obstruction to the urinary flow.

Dr. Willy Meyer. Dr. Ferguson mentioned one incision in the Bottini operation, but I always make three or four. The reason I brought this paper before the Association is because I wanted to state that the Bottini operation has its place. We should not simply say that we treat this disease by prostatectomy only, nor should anyone say we should do the Bottini and no other, but we must select our cases.

MYOSITIS OSSIFICANS TRAUMATICA.

By J. F. BINNIE, C.M.,
KANSAS CITY.

Bone may be formed in muscle or tendon under several distinct conditions. In the first place, there may be a process of ossification attacking one muscle after another, especially those of the trunk posteriorly, until the patient is in a truly pitiable state. The cause is totally unknown, but our profession has named the disease myositis ossificans progressiva, while the showman dubs the victim "the ossified man." I believe progressive ossifying myositis less uncommon than is usually supposed, as in the course of the present inquiry I have run across the tracks of several cases.

Another well-known condition in which bone forms in muscle or tendon is the result of slight traumata frequently repeated during a more or less extended period of time. Well-known examples of this condition are "rider's bone," in the origin of the adductors of the thigh; "cavalryman's bone," an osseous plate where the sabre hits the outer side of the thigh; "drill bone," in the deltoid; "fencer's bone," in the brachialis anticus, due to repeated overextension of that muscle incident to the peculiar mode of fencing adopted by the German students in their duels.

Lastly, there is the so-called myositis ossificans traumatica, where a mass of bone forms in a muscle after a single injury. It is with this condition that the present paper has to do, and the subject may be introduced most easily by the recitation of an individual case.

G. O., aged forty-one years, seen by me September 19, 1902. Two weeks ago, while boxing in a gymnasium, received a severe bruise on the right forearm and arm. Swelling and ecchymosis

were marked, but soon disappeared under domestic remedies. During the past two or three days has noticed a tumor in upper arm and pain on extending the elbow. On examination, one finds at the junction of the middle and lower thirds on the inner side of the right arm a tumor which passes down toward the elbow. The tumor is elongated, hard, size of a large thumb, movable from side to side, but not up and down; fairly tender. It is close to but not apparently intimately attached to the humerus, lies beneath the biceps, and is crossed by the brachial artery. There is no pulsation in the tumor, no radiating pain. Flexion of the elbow is normal; extension is slow and painful. There is no change in the sensibility, etc., of the hand. There is no elevation of temperature or acceleration of the pulse.

September 26, 1902. The tumor has increased slightly in size and disability is more marked. Chloroform; made longitudinal incision over the tumor. Retracted biceps to outer side and the brachial vessels and nerves to inner, exposing a grizzly, hard, non-vascular tumor lying in the brachialis anticus muscle. The tumor was separated from its muscular bed by sharp and blunt dissection. At its upper end it was attached to the humerus, but the attachment was easily separated by a blunt periosteal elevator, leaving an area of humerus one inch square denuded of periosteum, but *not* rough. The corresponding surface of the tumor was rough. Along with the tumor a considerable amount of the brachialis anticus muscle was excised. The wound was closed with catgut and healed *per primam*. There has been no recurrence to date (March, 1903) and there is no disability.

The tumor is hard, measures two inches in length by five-eighths, by three-quarters of an inch. On longitudinal section it presents the gross appearance of a medullated bone with a narrow, red marrow cavity. The bone is not very hard, can be cut with a knife, but yet contains much gritty bone salts.

The following pathological report was made by Dr. Frank Hall, Professor of Pathology, Kansas City Medical College:

"For convenience of description we may divide the fusiform

tumor into a proximal, middle, and distal part. The proximal portion forms a blunt cone, the middle a cylinder, and the distal a blunt cone. Immediately on removal, the tissue was fixed in a 4 per cent. solution of formaldehyde, decalcified in a 5 per cent. aqueous solution of nitric acid, rehardened in alcohol, embedded in celloidin, and cut into sections five micromillimetres thick. Staining was accomplished with hæmatoxylin in combination with eosin or picrofuchsin. Instructive results were also obtained with methylene blue and eosin. The cone-shaped proximal and distal portions of the tumor were sectioned parallel to the axis, yielding triangular sections; the middle portion was cut transversely, giving rectangular sections, one side presenting the muscular envelope of the tumor mass, the opposite side the ragged surface of the small central medullary canal. The proximal sections present for examination bundles of longitudinally cut voluntary muscles, intermuscular connective tissue, bloodvessels, and a small amount of fat. The muscle fibres are wavy, variable in diameter, and present very distinct longitudinal fibrillation with but faint transverse striations. The fibres generally react normally to eosin, but here and there one takes on a deep red stain, either throughout its length or only in segments. These darker fibres or segments of fibres are seen, with the high power, to have lost both longitudinal and transverse striations and to be converted into homogeneous or finely granular masses. The sarcolemma of these affected fibres is more richly nucleated than normal, the nuclei being large, round, and sharply projecting. In a few instances a fibre or a portion of a fibre is represented by a thin granular mass enclosed in a shrunken sarcolemma.

"The intermuscular connective tissue, composing the endomysium and perimysium, presents changes varying in quantity in different regions of the section. The perimysium is irregularly increased throughout, but more especially toward the base of the triangular sections—*i. e.*, toward the centre of the tumor. Changes in this connective tissue are recognizable by a loss of distinct fibrillation and by a failure to react normally to eosin, the color presented being a dark purple. The texture is in part massive, coarsely

granular, in part thinly reticulated, the meshes occupied by a fine granular precipitate. The larger masses of connective tissue occur around the bloodvessels and increase in size, progressively, as the base of the section is approached. The nuclei are reduced in number, are either round or dash-shaped, and are darkly stained. At the base of the section the connective tissue suddenly broadens out like a fan, engulfing the muscle fibres and destroying most of them. This region presents a dense mass of tightly compact spindle cells with small linear nuclei. At the centre of the base of the section the density is broken by infiltrating red blood cells, large epithelial cells, and a few giant cells. The cells are the precursors of the ossified areas present in the centre of the tumor. The endomysium throughout the section is reduced to a thinly reticulated mass of fine fibrils, forming spaces filled with shadows of red blood corpuscles and fine granular débris. The nuclei are free and lie scattered about in the reticulum. The bloodvessels throughout the apical region of the section are normal in number, engorged with corpuscles, and surrounded by an increased mass of connective tissue. Many of the vessels are apparently subjected to increased pressure, as is shown by their distorted lumina. The fatty mass at the apex of the section presents nothing abnormal save that its connective tissue is of the same character as that found elsewhere in the section.

"The sections cut from the middle portion of the tumor present the processes exemplified by this material in full blossom. Externally, masses of muscle fibres in cross-section present for inspection. Here we find many dark, red-stained fibres interspersed with normal ones, as noted in the proximal sections. Approaching the centre of the section the intermuscular connective tissue becomes progressively broadened and thickened with more and more abundant linear nuclei and fewer and fewer bloodvessels. No possible line of demarcation can be detected between the muscular envelope and the osseous centre. Spicules of bone and islands of cartilage arise amidst the masses of intermuscular connective tissue. In many places connective tissue is transformed directly into bone; in other areas the connective tissue cells seem to surround themselves with

a capsule and gradually form about themselves the characteristic homogeneous, blue-staining cartilage matrix. As we approach the centre of the tumor the bony trabeculæ developing about and between the muscular fibres push them farther apart, destroying some of them, enclosing others in a tight embrace. The enclosed fibres of muscle vary much in diameter. Some are much larger than normal; others are reduced to little more than pink dots. In some of the fibres one finds, under the high power, several nuclei; in others the centre is vacuolated or reduced to amorphous granules. In many instances the sarcolemma is penetrated by red blood cells, thus forming a sheath about the sarcous substance. In a few instances the red cells even penetrate into the centres of the fibres. Strangely enough, a few muscle fibres in a fair state of preservation persist in the very centre of the tumor. On close inspection the new-formed bone is seen to be fairly perfectly formed. Each trabecula is clothed in a thick tunic of cubical osteoblasts which come to lie enclosed in lacunæ as the process of ossification advances. The islands of cartilage begin to ossify at their periphery.

"The forming bone reacts to eosin; thus the bony trabeculæ and borders of the cartilage areas are of varying shades of pink. Marrow spaces are abundant and are occupied by a perfect chaos of spindle cells, red blood cells, muscle fibres, and multinucleated giant cells. Plasma cells are present, but not abundant. The bloodvessels of the marrow are remarkably few and imperfectly formed. Erythrocytes evenly infiltrate every available space in the marrow. In the centre of the growth are several blood cysts of varying sizes. Some contain well-preserved erythrocytes; others are occupied by a reticulated mass of fine fibrils and amorphous granules.

"The distal portion of the tumor resembles the proximal in every respect. The intermuscular tissues are somewhat more abundant and grade to the normal more gradually. Certain deeply-pigmented cells are scattered in the stroma. These are doubtless wandering cells which have taken up coarse-brown granules of blood pigment."

A number of explanations have been forthcoming as to the origin of intramuscular masses of bone after trauma, and each of the explanations has been subjected to keen criticism.

1. One of the earliest theories expounded was that, as a result of the injury, blood was effused and this blood became transformed into bone. This theory might have passed muster in the days when it was believed that tissues were regenerated by the direct metamorphosis of blood corpuscles into connective tissue.

2. The second theory demanding attention is one of great importance and is undoubtedly correct in many cases. It accuses the periosteum of being the "fons et irigo mali." Osteomata may arise from the periosteum in several ways:

(*a*) A severe blow is inflicted. The muscle affected is crushed into a pulp. There is injury to a limited and adjacent area of periosteum. The cells of the injured periosteum proliferate, escape into the pulpy area of muscle and there develop. A mass of bone is formed which may have only a loose connection with the periosteum or may become entirely detached from it. (F. Berndt.)

(*b*) A muscle is in action, receives a blow; some of its fibres tear themselves loose from their bony origin and, retracting into the mass of muscle still connected with the bone, carry with them particles of periosteum. These particles of periosteum grow in their new environments, are true bone grafts, and can form intramuscular osteomata, unconnected with, though originating from, the periosteum. (Boppe, Demmler, quoted by C. Lyot, *Traité de Chirurgie.* Le Dentu et Delbet, iv. 776.)

Berthier, to prove this theory, detached in rabbits, with a knife, little flaps of periosteum, and by electrical stimulation of the muscles he succeeded in having these flaps pulled away from the bones, and in time found that where they were there developed little nodes, first, of cartilage, then of bone. Delorme was never able to detach periosteum from bone by any force applied to the adductors of the thigh in the cadaver.

(*c*) As a result of one trauma a regular flap of periosteum is detached from the bone in whole or in part, and being drawn into

the belly of a muscle develops there, forming an osteoma. It is said that a bone cyst may be formed in the above manner.

F. Schultz writes (*Beitrage z. klin. Chir.*, Band xxxiii. 541): One must assume that a flap of periosteum was torn entirely free from the femur (he is speaking of a definite case), that this became separated from the bone by blood and fragments of contused and lacerated tissue. The separated flap of periosteum reacts normally to the stimulus of injury by proliferation and ossification; thus a plate of bone is formed separated from the femur by the blood and detritus referred to. But the wounded periosteum surrounding the bone left bare by the detachment of the periosteal flap also reacts to the injury and forms bone, and this new bone meets and fuses with the bone formed in the aforesaid flap; thus a complete bony wall is formed around the blood and detritus and the cyst formation is complete. This notion of Schultz's by no means explains the occurrence of cysts unconnected with the bone; such might possibly arise from the separated fragment of periosteum becoming rolled up in the shape of a capsule around a blood clot or collection of detritus. If this rolling up occurred and the periosteal cells proliferated and ossified, then, presumably, a blood cyst might be formed.

3. A third theory, that of Cahen, involves the adoption of the famous Cohnheim theory of the origin of tumors. Cahen considers the osteoma primarily muscular and, when connected with a bone, this connection entirely secondary. He assumes that there have been present in the muscle aberrant masses of embryonic material originally provided for the development of the normal bone, but unused; they have lain in the muscle until stimulated to growth by the trauma. Undoubtedly fetal remnants of various kinds are scattered in various parts of the body—*e. g.*, remnants of the branchial clefts in the neck and of the primitive suprarenal body in the kidney—and as undoubtedly, when subjected to the proper stimulus, these develop into more or less complicated epithelial tumors and cysts in the neck and into hypernephromata in the kidney; so that we are compelled to admit the entire possibility of Cahen's assumption. The probability of the assumption is another matter,

and, as there are other and simpler explanations of the condition, one need only bear in mind that such an origin is within the range of possibility, but is so very improbable that it need not be considered with much seriousness.

4. Ziegler assumes that in patients the subjects of myositis ossificans, whether traumatic or progressive, there is a congenital diathesis of the connective tissue of the muscles, fascia, tendons, ligaments, etc., in that they become endowed with powers normally belonging to the periosteum alone. This theory is closely related to the Reichert notion of the connective tissues. Reichert considers that all those tissues which are composed of cells lying in an intermediary or ground substance (bone, cartilage, connective tissue, etc.) are morphological equivalents each capable, under suitable conditions, of replacing the others. As Pierre Delbet says, "The development of osteomata separate from the skeleton is a powerful argument in favor of Reichert's theory." In the case of progressive myositis ossificans the assumption of Ziegler or the theory of Reichert must be accepted either *in toto* or in some modified form; here there can be no question of periosteal origin; the condition seems to be one of proliferation and metamorphosis of the intramuscular connective tissue. When the so-called myositis ossificans is limited to one muscle and is the result of a single trauma, there can be little or no doubt that the ossification may proceed from the injured—*i. e.*, the stimulated—periosteum; but that it does so in all cases is hard to believe. Observers have differed in their opinions as to whether the process under consideration is a tumor or an inflammation. Grawitz and Salmon, under Bergmann's auspices (quoted by Rothschild), investigated this matter and, basing their opinion on clinical and microscopic evidence, pronounced the disease inflammatory. Clinically, they found that the temperature was frequently elevated in the early stages and that the acuteness, the amount of swelling, and the tenderness of the affected muscles all indicated inflammation, while microscopically there was early cloudiness, later degeneration of the muscular fibres; small-cell infiltration of the connective tissues around the altered parenchyma; the presence and enlargement of bloodvessels in the neighborhood.

Virchow and most of the older writers think the disease belongs to the borderland between inflammation and tumor, while later pathologists, as Ziegler, Birch-Hirschfeld, and others, lean toward the tumor hypothesis.

It will be noticed that in my case ossification is as far advanced in the distal as in the proximal portions, that around and throughout the tumor there is great proliferation of the intramuscular connective tissue, that ossification is both of the fibrous and cartilaginous type, and that muscle fibres in every stage of degeneration are scattered here, there, and everywhere, lying in the connective tissue, in among the islands of cartilage, and hugged by the trabeculæ of bone. There is no microscopic evidence of any inflammatory changes. If this case is one of purely periosteal origin, then the scattering of the periosteal cells or grafts must have been through a territory extraordinary in length and in latitude wonderfully limited. Its origin from a separated periosteal flap is simply inconceivable in view of its relations to the innumerable discrete and degenerating muscular fibres. From careful examination of this one case even, one is forced to admit the possibility and probability of the bone tumor being the result of proliferation and metamorphosis of the intramuscular connective tissue.

Rothschild's first case supports this view. The tumor developed in six weeks in the brachialis anticus and required removal from the humerus by the chisel. The surface of the humerus at the point where the tumor had been attached was so rough that it gave the impression that a portion of the superficial layers of the bone had been removed with the tumor. Really this roughness was due to a deposit on the bone which, when removed with the chisel, showed intact periosteum under.

The following cases, most of which were kindly communicated to me by the surgeons in charge, seem to substantiate the muscular origin of the tumors under consideration:

Rixford, E. (San Francisco). H. H. C., physician, aged sixty-five years, operated April 15, 1902, for pyloric obstruction. Median incision beginning at the xiphoid, was made and the sheaths of

both rectus muscles opened. The operation on the pylorus had to be abandoned and a simple posterior gastroenterostomy was done with a Murphy button. Abdominal wall closed in layers with catgut. Recovery rapid. On the seventh day the wound appeared to have healed by primary union. On the tenth day a few cubic centimetres of pus were found at the upper end of the incision. The small cavity was packed with lint saturated in turpentine and oil and rapidly closed. The patient rapidly gained in flesh and strength and had no discomfort until August, when he had a sharp pain in the cicatrix when he made certain movements. He discovered a small hard mass in the left rectus. In November the bone was about five centimetres long and one centimetre wide. It was *not* attached to the xiphoid, but reached very near it and was in the edge of the muscle.

February 11, 1903. The bone tumor now measures three inches in length and three-quarters of an inch in width and is separated from the xiphoid by nearly one-half an inch. It causes no discomfort except when the patient bends forward and then the sharp ends of the bone prick.

Macdonald, W. G. (Albany, N. Y.). Manufacturer, aged fifty years, who some twenty years previously had received an injury to his chest as a result of an explosion. There was considerable destruction of the skin and subsequently numerous areas of deposit of bone in the pectoralis major. My best recollection is that there were several areas extirpated and that the disease first made its appearance distinctly some six or eight years after the primary injury.

Marks, S. (Milwaukee, Wis.). On the eve of battle I was consulted by a soldier for not only bowel trouble, but for what he called a hard lump located about the middle of the left sartorius muscle. He informed me that it was the result of a blow received some five or six years previously, which made him lame for some time. He said, however, that he was entirely well at the time of enlistment. I regarded it as bony matter. If my memory serves me, he was wounded the next day but one after my examination and died soon after. I procured the specimen, which was about one-eighth of an

inch thick and slightly oval and about one inch in length, but in the hurry of movements I lost not only that but many other valuable specimens.

Gaston, J. McFadden (Atlanta, Ga.). W. H. E., aged sixty years; old double hydrocele. Injection of Lugol's solution. He presented symptoms of inflammation altogether disproportionate to the treatment given. By incision there was removed pus, disintegrated tissues, and then an osseous formation; recovery. There was absolutely no mistaking the bony mass, which was about the size of a walnut. The existence of this was traceable to an injury to the testicles and the muscles years before.

Elliot, J. W. (Boston, Mass.), through the courtesy of Dr. H. B Howard. E. H., aged thirty-six years, admitted to the Massachusetts General Hospital, May 20, 1902. In February, 1902, while working, a box weighing four hundred pounds fell on his right leg; skin on the outside of the thigh was scratched and the leg rapidly became swollen. Pained him considerably and he stopped work for a week on account of stiffness. Then he returned to work for four weeks; he found then it was very painful to go up and down stairs, so he had to give up work and has not worked since. Pain is just above the joint and feels as if a knife was run into it. Swelling of the leg was reduced with poultices, but of late is becoming hard and appears to be growing larger down toward the joint. On May 31st an incision was made just outside of the vastus externus down onto the tumor. This consisted of a mass of soft spongy bone laid on over the femur and was chiselled off, leaving the shaft and periosteum apparently intact. No sarcoma was found by the microscope. Result: relieved.

F. Munro (Middlesborough, Eng., *Lancet*, 1891, vol. i. p. 427). T. A., aged twenty-four years. May 15, 1890. Playing at football on Easter Wednesday, received a blow from another player's knee in front of right thigh. One week afterward noticed hard swelling one and a half inches above the outer side of the knee. On examination five weeks after injury "there was found what seemed to be a lump of bone lying loose in the muscles of the outer side of the thigh. It was about eight inches long, narrow, and projecting

at its lower end and approaching the surface, but broadening out as it passed up the thigh and lying more in the muscles. It was slightly movable except at its upper end."

June 1. *Operation.* The mass lay in the substance of the vastus externus, being separated from the femur by a sheet of fibres. The mass was a slightly curved plate about eight inches long, arising from the origin of the vastus and the linea aspera. It was fully a quarter of an inch thick at its origin, thinning as it passed outward and downward. Prof. Greenfield, of Edinburgh, examined the specimen and pronounced it typical myositis ossificans, differing from Orlow's case, which he cites, in not being so vascular and not containing cartilage. Orlow's case (*Virchow's Annual*, 1889) was one of medullated, dark red bone, without any distinct cortical substance, lying in the upper end of adductor longus muscle, and seen five months after injury sustained. Orlow believed both periosteum and intermuscular connective tissue took part in the formation of the bone.

Vulpius (Heidelberg, *Verhandlungen der Deutschen Ges. f. Chir.*, 1902). J. Z., aged twenty-one years, male, fell on an iron bar, hitting the left thigh. Pain; worked for three weeks. Condition got much worse almost in one night. Could not bend the knee; thigh tender and swollen. On examination, four weeks after injury, there was found distinct swelling of the flexor aspect of the thigh, midway between "spina" and patella. Skin unaltered; tumor long, firm; its centre of bony hardness; not tender; movable on the femur with slight crepitation. The knee can be fully extended both actively and passively, but power is decreased. Flexion is possible to one hundred and fifty degrees, but then firm obstruction is encountered.

Operation. Incision at the outer edge of the tumor, which was found surrounded by firm, tendon-like connective tissue. In several places indurations penetrated farther into the muscle, and in the centre of these indurations there were bony, hard bodies. Blunt dissection was impossible because of close union with the muscle. The tumor was a cyst surrounded by a complete shell of bone varying in thickness. The cyst was removed in two pieces, as also

the neighboring indurations. Neither the femur nor its periosteum was exposed or injured. The tumor on its femoral side was covered by a large layer of degenerated muscle. The cyst was 12 cm. long, 3 to 4 cm. high, and 2 to 2½ cm. wide. The circumference was 10 to 11 cm. At places the bone was translucent; at others it was 2 mm. thick; its cavity was lined with uniform, glistening, bluish membrane which sent septa from one part of the walls to another. The contents of the cyst were extravasated blood.

Bernays (St. Louis). Miner, aged forty-five years, from Colorado, had received numerous bumps from an ore box or basket hitting him just above the knee of the right side. There was a tumor as large as half a small cantaloupe in the quadriceps, which felt hard in spots, of indefinite origin as to time, and slow growth. Extirpation showed an osteoma in the vastus internus extending into the externus, which contained cyst-like cavities filled with mucoid jelly. This was clearly a muscular osteoma and had no connection with the bone or periosteum, unless the attachment of the muscles to the patella are considered, and the tumor was fully four inches above the patella. Extirpation; primary union; no loss of function. While this case of Bernays' seems to have followed repeated traumata, yet it is so distinctly an example of traumatic myositis without periosteal involvement that it is included here.

Schüler, Heinrich (*Beitrage z. klin. Chir.*, Band xxxiii. 556), in his excellent "arbeit" based on v. Braun's material, admits fully the existence of myositis ossificans traumatica, although his paper is concerned with the very similar condition known as traumatic exostoses. He writes: "Such traumatic bone tumors appear to be very rare, much rarer than traumatic bony neoplasms in the muscles, and we have failed to find any such case in literature since Honsell's publication (from the same clinic)."

In all the cases reported by Schüler there was a single trauma; in no case was there evidence of a hæmatoma. The tumors only became noticeable after weeks. The immediate swelling was always slight. In one case the arrangement of tendon tissue on the fragment removed showed that the fragment must have been the point of insertion of the tendon and that at the moment of

injury the tendon pulled off a portion of periosteum with fragments of bone attached. In all the cases periosteum covered the tumors and was firmly united to them, though here and there it showed pathological thickenings. *The musculature was never in any structural relation with the tumors.* The muscle lay on the surface and could be separated by blunt dissection.

It will be seen that there is a very sharp distinction existing between the cases reported by Schüler under the title "traumatic exostoses" and such cases as that reported by me. Undoubtedly many of the cases classed as "myositis ossificans" are truly exostoses, and one might well consider all cases which are of purely periosteal origin to be such; but the difficulty or impossibility of clinically separating the tumors of one origin from those of the other makes it convenient to class them together, and then, to avoid the introduction of theories into nomenclature, we might label such cases "traumatic osteomata," connected or unconnected with the skeleton, as the case may be.

Sometimes, instead of one muscle being the seat of an osteoma, one whole group of muscles is affected. Bernays (St. Louis) sent me the following report of a boy, aged ten years and of excellent family history:

"Tumor of most peculiar shape. I have never seen anything like it in my life. The entire flexor group of muscles arising from the internal condyle of the humerus seemed to be enlarged, swollen, and hardened. Palpation detected hard, spicula-like pieces of bone in the tumor mass. These were only found in the muscular bellies of the flexors. I thought it to be a malignant tumor and advised extirpation, probably to be followed by an amputation. I removed the mass, leaving a sadly mutilated forearm. . . . Primary union. Microscopic examination (and in fact, macroscopically I thought the tumor non-malignant) proved it to be a lipoma intramuscularis angiomatodes ossificans. There were irregular, branched, and sponge-like osteomata in four of the muscle bellies. Function now, three or four years after operation, is remarkable, although only the supinator longus was left. The small muscles of the hand have developed immensely. . . ."

In progressive myositis ossificans the process affects fasciæ and tendons as well as muscles. Rothschild has only seen one case where, as a result of trauma, there was isolated ossification of tendon, and he has found no reports of such cases, although, as he points out, ossification of tendon is the same in principle as that of muscle, where the process takes place in the intramuscular fibrous tissue.

Rothschild's case. P. K., aged forty-five years. December 20, 1899, heavy coal wagon went over his left foot. In hospital ten weeks. At the end of this time there was severe pain running from the tendo Achillis round both malleoli to the dorsum of the foot. The patient was unable to walk.

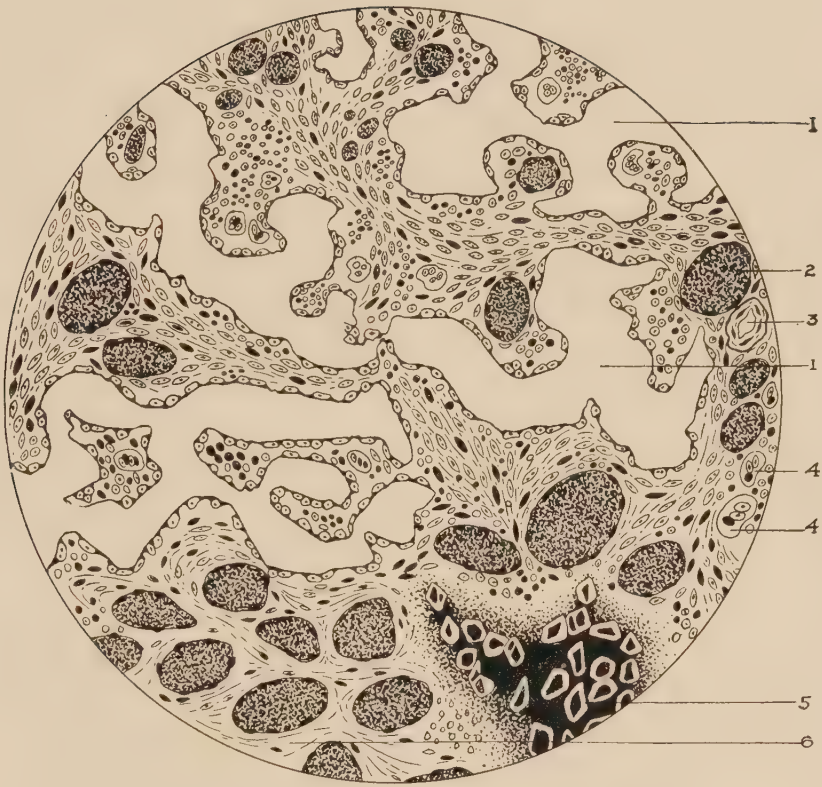
March 3, 1900. Temperature and pulse normal; left leg from the middle of the foot to above the malleoli œdematous; contour of ankle lost; motion in talocrural and talocalcaneonavicular joints normal. Left tendo Achillis was neither visible nor palpable in any position, but in its place is a broad, bony, hard mass springing from the calcaneum, corresponding to the tendo Achillis, reaching to three finger-breadths above the tuberosity of the os calcis and apparently losing itself in the flexor muscles. The right and left margins of the growth are well defined. Œdema rapidly increases on walking. Skiagram shows a spur of bone corresponding to the tendo Achillis.

12*th*. Operation by Prof. Rehn. Most of the tendon has been replaced by an immobile mass of bone lying in tendon tissue. The tumor was separated from the os calcis by a chisel, from remnants of tendon by sharp dissection; recovery.

Microscopic examination shows connective tissue becoming metamorphosed into cartilage. The long spindle cells become gradually thicker and rounder, surround themselves with a capsule, and enclose a vesicular nucleus until they become true cartilage cells. The cartilage may be seen changing into bone. The cells first lose their capsule, become smaller and thinner, and the intercellular substance becomes denser and opaque.

Finney, J. M. T. (Baltimore), has reported to me a case very similar to the above, although the history of an individual injury

FIG. 1.



1. Bone trabecula. 2 Cross-section of voluntary muscle fibre. 3. Cross-section of blood-vessel. 4. Multinuclear giant cell. 5. Area of cartilage. 6. Intermuscular connective tissue. (Drawn by Dr. Frank Hall.)

Skiagram of Dr. J. M. T. Finney's case of osteoma in tendo Achillis.

is not so definite. "The patient was a minister, about fifty years old, who had noticed, following the use of a new, rather tight shoe, a tenderness along the right tendo Achillis. This continued to bother him for some months, until finally he consulted me as to the cause of his trouble. I found a thickened tendo Achillis with external evidence of injury from the top of the shoe in the nature of callus formation, and on examining the tendo Achillis found a hard substance that felt very much like bone. It was about one and one-half inches long by one-half inch in thickness. I had an X-ray taken of both feet, and this showed that the hard substance I felt was true bone, while on the opposite side there was no evidence of bone formation whatever. The patient assured me that the two tendons were alike before the injury spoken of, and that he had noticed himself the formation of this bone in the tendon. I have not seen him for about eight months, but at the end of that time the bone formation had progressed perceptibly since my first examination. I am not quite sure whether the bone was confined entirely to the tendon or whether or not it had involved to a certain extent the lower portion of the muscle, since I did not operate."

Statistics. For the sake of convenience, I will place all the cases of traumatic osteomata, whether connected or unconnected with the skeleton, in one group, indicating by a double asterisk those considered by the authors themselves to be traumatic exostoses. Although I have verified most of the references given in Rothschild's and Vulpius' lists, yet it will be convenient to omit the numerous individual references. The cases marked by a single asterisk have been reported to me by personal communication. I desire to take this opportunity of expressing my sincere thanks to the numerous colleagues, both in America and Europe, who have, at the expense of time and trouble, most kindly and courteously aided me in the preparation of this paper. Especially are my thanks due to my friend Dr. Frank Hall, for the beautiful preparations and drawings he has made from my specimens.

Dr. Otto Rothschild. "Ueber Myositis ossificans traumatica."
(*Beiträge zur klinischen Chirurgie*, 1900, Band xxviii. 1.)

1816.	Otto,	Diaphragm	1
1854.	Schuh,	Vastus ext.	1
1856.	Rokitansky,	Biceps	1
1863.	v. Pitka,	*a.* Brach. int.	1
		b. Both brach. int.	2
	Barth,	Rect. fem.	1
	Sangalli,	Digastric	1
1873.	Podratzky,	Brach. ant.	1
	Billroth,	Biceps	1
	Ebstein,	Iliopsoas	1
	Busch,	Psoas	1
	Konetschke,	Gluteus max.	1
	Weinlechner,	Ant. of thigh	1
	Meinhold,	Quadriceps	1
	Rasmussen,	Brach. ant.	2
	Cahen,	Vastus ext.	1
		Quadriceps	2
		Brach. ant.	1
	Salman,	Iliopsoas. [Trauma ?]	
	Ruthke,	Ant. of thigh	1
	Bremig,	Shoulder	1
		Vastus int.	1
		Vastus med. and ext.	1
	Rothschild,	Brach. ant.	1
		Tendo Achillis	1

Dr. Oscar Vulpius (Heidelberg). "Zur Kenntniss der intra-musculären Knochenbildung nach Trauma."
(*Verhandlungen der Deutschen Ges. für Chir.*, 1902, vol. ii. p. 127.)

Grunbaum		2
Elbogan		3
Schnitz		7
Sudeck		1
Regnier,	Brach. ant.	2
Zhober and Okioz		2
Zimmerman		1

Dr. Rammstedt (Halle). (*Archiv für klin. Chir.*, vol. lxi. p. 153.)

Martin,	Vastus int.	1
Rammstedt,	Vastus int.	2

Dr. Berndt. (*Archiv für klin. Chir.*, vol. lxv. p. 2.)

In muscles outer side thigh (Two were in same patient from separate kicks.)	3

Dr. O. Wolter. "Ueber Myositis ossificans traumatica mit Bildung von Lymphcysten." (*Deutsche Zeitschrift für Chir.*, vol. lxiv. p. 318. Ref. *Centralblatt für Chir.*, Dec. 6, 1902.)

Extensor of thigh	2

Dr. Graf. "Zur Casuistik der traumatischen Ossificerenden Myositis." (*Archiv für klin. Chir.*, vol. lxvi. p. 1105.)

Adductor magnus	1

W. Mysch. (*Deutsche Zeitschrift für Chir.*, vol. liv. p. 207. Ref. *Centralblatt für Chir.*, August 4, 1900.)

Brach. anticus	1

Hoffmann. (*Deutsche militärarztliche Zeitschrift*, 1902, No. 4. Ref. *Centralblatt für Chir.*, 1902, No. 37.)

Brachialis anticus 2

Dr. F. Schulz (Rostock). (*Beiträge zur klin. Chir.*, vol. xxxiii. p. 541.)

** Schulz, Quadriceps 1
** Honsell, Outer side thigh 2

Dr. Heinrich Schüler (Tübingen). (*Beiträge zur klin. Chir.*, vol. xxxiii. p. 556.)

** Deltoid 1
** Anterior of thigh 1
** Upper half femur 1

F. Munro. (*Lancet*, 1891, vol. i. p. 427.)

Vastus externus 1
Orlow. Adductor longus 1

J. Hutchinson, Jr. (*Trans. Clin. Society*, London, 1898–99, vol. xxxii. p. 230.)

Brachialis anticus 1

F. Eve. (*Trans. Clin. Society*, London, vol. xxxii. p. 232.)

Crureus and vasti 1

C. Lyot. (*Traité de Chir. Clin. et Op. Le Dentu et Delbet.*)

Demmler. Triceps cruralis 1
Orion 1

* W. J. Taylor, Philadelphia. Ant. thigh 1
* J. C. Oliver, Cincinnati. Triceps tendon 1
* W. G. Macdonald, Albany. Pectoralis major . . . . . 1; Gastrocnemius 1
* J. M. T. Finney, Baltimore. Tendo Achillis 1
* S. Marks, Milwaukee. Sartorius 1
* McF. Gaston, Atlanta. Cremaster 1
* R. Matas, New Orleans. Adductor longus 1
* E. Rixford, San Francisco. Rectus abdominalis 1
* F. E. Banks, Cleveland. Upper arm (seen very casually) . 1
* S. H. Weeks, Portland, Me. Pectoralis major 1
* A. C. Bernays, St. Louis. Flexors forearm . . . . 1; Quadriceps . . . . . 1; Gastrocnemius 1

* By courtesy of Dr. H. B. Howard, Massachusetts General Hospital:
Service of Dr. Harrington. Vastus ext. 1
Service of J. W. Elliot . Outer side upper third thigh . . 1
Case reported by the writer. Brach. ant. 1

Total number of cases 86

Weeks, S. H. (Portland, Me.). Man, thirty to thirty-five years of age. Right hand and forearm caught between heavy cross-rollers, which resulted in crushing the soft parts and breaking the humerus in two or three places. The fractures united, the soft parts healed, and he has a useful arm. The attending physician found a hard mass in the lower border of the pectoralis major between two and three inches from its insertion into the humerus. On examination, Weeks found in the free border of the muscle as

it crosses the axilla a hard mass as large as a walnut, as dense and hard as bone. Diagnosis, myositis ossificans traumatica. Weeks only saw the case once.

Harrington, F. B. (by courtesy of H. B. Howard, Boston). E. T. M., aged thirty-eight years, sailor. July 23, 1901.

Past History. Good until fifteen months ago. Gonorrhœa; no syphilis; tabes for past fifteen months; worse of late; lightning pains; partial blindness in right eye.

Present History. Five weeks ago wrenched thigh; ecchymosis from knee to hip. When swelling of thigh went down he noticed a hard tumor attached to the femur high up; moves on moving leg; cannot walk without pain, nor can he walk in a dark room. Tumor has increased slowly in size.

Present Examination. . . . Hard, nodular, irregularly rounded mass immovably attached to and on outer side of upper third of femur on the right side. Felt above Poupart's ligament. Does not fluctuate; no tenderness.

Operation, July 27th. Incision three inches long made over prominent part of tumor on front of thigh just above level of the trochanter. Small piece of tumor chiselled out. Tumor apparently developing in muscle sheath. Resembled normal cancellated bone.

Taylor, William J. (Philadelphia). Man, aged twenty-three years; vigorous health; no rheumatic or specific history; is a horseman. On December 15, 1900, he was kicked by a horse on the anterior portion of the left thigh about the middle. The blow was severe, but, on being assisted onto his horse, he rode home. Intense pain; has ridden constantly since, though latterly insecure in his seat while riding a restless horse, as he could not hold on with his knees without pain. When seen, January 5, 1901, three weeks after trauma, there was marked swelling on anterior of thigh, over which the muscles rolled easily, but did not give a sense of a solid tumor, rather of an organized hæmatoma deep under the muscles. No pain except on certain movements, principally flexion of knee.

Operation, January 8th. Incision. Swelling quite hard. The periosteum was broken down with quite a blood clot beneath it, and

certain of the muscles had apparently undergone degeneration, in which there were a number of small, hard masses resembling bone. The pathologist reported that the degenerative and necrotic changes going on in the muscles associated with the presence of newly formed bone in the connective tissue led him to suspect that it was a myositis with a tendency toward the formation of new bone. No evidence of malignancy.

DISCUSSION.

Dr. S. H. Weeks, of Portland, Maine.

We are very much indebted to Dr. Binnie for his paper. A great deal of labor must have been necessary to gather such a large number of cases. As to the origin of these growths, it does not seem to me that a definite and satisfactory explanation has been reached. The only case I have seen occurred in a young man, aged twenty-five years, who had received an injury to the arm by being caught between two heavy bodies. The bone was broken in several places, and the muscles and soft parts of the arm were very much injured. A few months later the fracture had thoroughly united, and function had been restored, when there appeared in the lower margin of the pectoralis major muscle a hard mass, which grew until it reached the size of an almond. It was hard and felt like bone. It was dense, and had all the characteristics of bone. If periosteal elements had been the starting point of the bony formation we should expect to find the bone in the coracobrachialis or in the biceps muscles which lie in contact with the bone. Inasmuch as it formed in the lower margin of the pectoralis major, several inches from the broken bone, it does not seem as if this theory holds true.

METHOD OF INSTRUCTION IN SURGICAL PATHOLOGY.

By J. C. BLOODGOOD, M.D.,
BALTIMORE, MD.

Clinical instruction in the out-patient department and in the hospital wards has, and will always have, certain defects and limitations as a complete method of instruction.

The question to be solved is: Can these limitations and defects be removed?

The method of instruction in the surgical pathological laboratory of the Johns Hopkins Hospital has reached a sufficiently satisfactory development to at least justify its presentation as a possible solution of the problem of teaching surgery.

Clinical instruction in the out-patient department and in the wards must, to a very large extent, be limited to the observation of the patients treated. The usual time spent by a student in the hospital dispensary and wards is two years. During this time many important surgical diseases are seen not at all or so seldom that the student does not get a clear or lasting clinical picture of the disease. Of necessity, examples of the various surgical diseases present themselves in no systematic order, and are so scattered that the student seldom, if ever, can observe in the dispensary, or even in the ward, at the same time the different varieties of affections of a single organ or part. Even in the ward it is very difficult to arrange that the student follow the patient from the admission, through the operation and after-treatment, to present to the student the diagnosis confirmed in the pathological laboratory, and the result of the treatment when the patient leaves the hospital, and never the ultimate result many years afterward.

Although the time between the admission and discharge of the patient is frequently an interval of a few weeks, nevertheless it is a very difficult problem to keep all the students in the group familiar with even the important details in the history of each patient.

These limitations and defects can be remedied to a very large degree by the method of instruction in the surgical pathological laboratory.

We may describe this method briefly as follows:

The instruction to the third-year medical class in the surgical laboratory is divided into two parts. The first may be called the systematic part, in which instruction is given by pamphlets, museum specimens, microscopic sections, and illustrations. The second part may be called the routine instruction, which is limited to the fresh material sent to the laboratory from the operating-room or the autopsy-room.

First Part. For the systematic work the third-year student in the beginning of the year comes to the laboratory one afternoon each week. The class is divided into groups of not less than five and not more than ten. Each group is given a pamphlet and a box of microscopic slides stained and labelled. Near each group, on a table—a rolling table, if possible—are placed the museum specimens discussed in the special pamphlet given to this group. The pamphlet corresponds somewhat to a chapter in a text-book on surgery, for example, "Tumors and Inflammations of the Breast," "Malignant Tumors of Bone," "Inflammations and Tumors of the Thyroid," etc.—*i. e.*, each pamphlet discusses the various affections of a special organ or part. The pamphlet is divided into two parts. In the first part of the pamphlet, for example, "Inflammations and Tumors of the Breast," the student is given the number of cases treated during the life of the clinic in relation to the total number of surgical patients. This gives him at once an idea of the relative frequency of the diseases of this organ or part. Then follows classification of the various diseases with the number of cases admitted for treatment in the surgical clinic. Here the student learns the relative frequency

of the various affections of this organ. When no examples of certain rare affections have come to the clinic for observation, it is so stated. The pamphlet then proceeds to give a summary of the clinical history and picture, treatment, gross pathological appearance, and microscopic study of the various diseases of the organ discussed in the pamphlet, which have been observed in the clinic, and, most important, the ultimate result after leaving the hospital. This general summary corresponds somewhat to what is written in a chapter of a text-book on surgery. It has the advantage, however, similar to that of a monograph, in that it gives the summary of a certain number of specific cases, in each of which the diagnosis has been confirmed by a pathological study, and in which the ultimate result is known from a few months to many years. Descriptions of rare diseases not observed in the clinic can be made from the literature, with illustrations. The second part of the pamphlet gives the clinical history, the treatment, the description of the fresh specimen (which is preserved in the museum, and which the student can find on the table near the group to which he belongs. Then follows the microscopic description, and the student will find in his box of slides a section taken from the specimen he has just examined.

The general part of the pamphlet the student can read at home in connection with his text-book on surgery. When he comes to the laboratory he is advised to take a museum specimen, selecting the various diseases of the organ in a certain natural sequence. This specimen has a surgical and pathological number, which is indexed in the pamphlet, so that the student can quickly turn to the clinical history of this case; and as, in the majority of instances, some years have elapsed since the patient has left the hospital, the pamphlet is able to give him the ultimate result. Each museum specimen, therefore, is one identified with an individual, the clinical history and ultimate result of whom the student can read, and he can examine the microscopic section of the museum specimen by which the diagnosis was confirmed. By a careful reading of the pamphlet the student is brought in contact with the relation between the clinical, the gross pathological, and the confirming micro-

scopic diagnosis. In addition, in the pamphlet he will find photographs of the patient, illustrating the clinical appearance, diagrams, photographs of the fresh specimen, X-ray photographs (if made), and, in some instances, photographs of microscopic drawings, and quite frequently photographs of the ultimate result.

Each group, as stated before, is given a pamphlet and a box of microscopic slides, and near the group are the museum specimens discussed in the pamphlets. From time to time the groups exchange material, so that by the end of the third year a large field of surgery is covered.

I believe this method presents surgery to the student in just as systematic a manner as a didactic lecture, with the great advantage that he reads instead of listens, and with his reading he has object lessons illustrative of the text. I have found that very little demonstration is necessary. The student works quietly by himself, just as he should in the dissecting-room or chemical laboratory. He is brought in close contact with the disease—with each specimen he can get in a few minutes the entire history of the case and the ultimate result. This is impossible with the patient. While this work in the laboratory is going on the third-year student observes patients in the out-patient department and in the surgical clinic. When, for example, he sees a patient with the clinical appearance of an exophthalmic goitre he will have read in his pamphlet a summary of the clinical history, treatment, and ultimate results of all cases of exophthalmic goitre treated in the hospital up to that time; he will have examined the museum specimens of the thyroids removed and the microscopic sections; he will have seen numerous photographs before and after operation. In the fourth year he will be much better prepared to observe his patients clinically in the wards; when, for example, he sees a case of exophthalmic goitre in the ward he can go to the library in the hospital, and in a few minutes review his third-year instruction on this disease. If during the third and fourth year it is his misfortune to see few or no examples of various important diseases, he will, at least in his third year, have read the clinical history, seen the photographs, examined the museum and micro-

scopic sections of one or more examples. This systematic method, therefore, prepares the student to take better advantage of the patients he sees clinically in the dispensary and in the ward, and it fills the gaps which cannot be avoided in clinical teaching.

Although such a course is called surgical pathology, its ultimate aim is really clinical diagnosis, taught, however, from the museum specimen and microscopic section instead of the patient. Clinical instruction should and must always be considered the most important part of medical teaching, and the object of this laboratory course is by no means a substitute, but a supplement—its only object being to better prepare the student for instruction in the dispensary or at the bedside.

Such a laboratory course has the great advantage that it utilizes the material accumulated during the entire life of the surgical clinic. The student is brought in contact not only with the patients observed during his two years' course of instruction, but with the entire experience of the surgical clinic. This method stimulates better record, more careful descriptions of the fresh tissue removed at operation and autopsy, and their preservation in the museum; it becomes necessary to keep track of the patients treated in the surgical clinic; one is stimulated to get better illustrations, the history of every important case; every museum specimen, microscopic sections, and photographs, similar to a book in a hospital library, are accessible to the student.

The preparation of the pamphlets is not specially difficult. Once made they can be added to from year to year. The photographs necessary for a set of five to ten pamphlets and the microscopic sections will last for years. The museum specimen is practically indestructible.

In addition to the systematic course just described, the fresh material from the operations and autopsies is used. In the first part of the year each fresh specimen is assigned at once to a third-year student. The probabilities are that he has seen this patient in the dispensary or in the surgical clinic; in any event, he is instructed to make a summary of the clinical history and record the clinical diagnosis. He examines and makes a description of the fresh

specimen, and takes his own naked-eye diagnosis. The afternoon on which the entire class meets in the laboratory those students who have been assigned fresh material meet the instructor in a small room. The cases are discussed, frozen sections are exhibited. After the first of January the class meets on two afternoons in the week. By this time the students have had an opportunity, from the systematic course and from the study of a certain number of fresh specimens, to acquire a certain amount of familiarity with surgical diseases, and for this reason the demonstration of the fresh material is made before the entire class. The cases are presented by the student to whom the specimen was assigned. By this time the student has been brought in contact with the various surgical diseases from different standpoints. He has studied quite a number systematically in the pamphlets, illustrated by the museum specimen and microscopic section. He has examined personally a number of fresh specimens in conjunction with the clinical history. He has a certain number of cases clinically in the surgical dispensary and surgical clinic. For this reason the student can better appreciate now a general demonstration and discussion on the routine fresh material, so that, while he is continuing to study by himself the experience of the surgical clinic of the past, he is brought more and more in contact with the material of the present. It is my rule to exhibit those specimens which the student has seen fresh as material again when it has become an alcohol museum specimen, so that he can compare the difference between the fresh and the alcohol specimen. As much as possible the student is informed of the ultimate microscopic diagnosis.

About once a month a lantern-slide demonstration is given. The first demonstration, for example, on "Inflammations and Tumors of the Thyroid," is given the class after this pamphlet has been studied by each group. I am quite positive that the time necessary to give such a course is no more than that which would be taken by a course of didactic lectures. The properly prepared pamphlet is certainly better than any notes of a lecture which can be taken by a student. He can digest most surely what he reads

better than what he hears, especially if, during his reading, object lessons—in the shape of photographs, museum specimens, and microscopic sections—are before him. The instructor can confirm his talking to the demonstration of fresh specimens, to general remarks on certain more difficult problems, and to a certain amount of personal instruction. The method of teaching is not only more satisfactory to the student, but infinitely more so to the teacher.

Such a course may be a difficult one to establish, but when once established it can be maintained with a minimum of labor and a maximum of results. The good results are not only to the student, but to the teacher and to the surgical clinic.

DISCUSSION.

Dr. W. W. Keen, of Philadelphia.

I would like to express my very great gratification at this paper, and to make one suggestion. There are a good many schools where such a thing as this is not possible, as the material, laboratory conveniences, etc., are out of the question. I wish to ask Dr. Bloodgood if it would not be possible to publish very many of these illustrations, so that they might be used in other schools. The paper is a most admirable one.

Dr. Bloodgood. I doubt if I could find a publisher who would be willing to run the risk, as the expense is considerable. The printing is a small matter, but the photographs are expensive. I should be very glad to do it if any publisher would undertake the responsibility of the expense.

INTESTINAL LOCALIZATION.

A Study on the Cadaver for the Purpose of Determining to What Extent the Various Parts of the Small Intestine May Be Identified through an Abdominal Wound.

By GEORGE H. MONKS, M.D.,
BOSTON.

It has always seemed somewhat strange to me that so little has been done in the way of a systematic study of the characteristics of the different parts of the small intestine and its mesentery for the purpose of assisting the surgeon to determine, when a loop of small intestine appears in an abdominal wound, what the approximate *position* of that loop is in reference to the rest of the intestine, and, incidentally, what the *direction* of the tube is in the loop—that is to say, which end will lead to the duodenum and which to the ileocæcal valve.

It is, of course, true that in most abdominal operations such information concerning the position and direction of any loop of small intestine would be of no real service to the surgeon. He has no concern about the intestine except to get it out of the way by retracting or by gauze packing, which he naturally proceeds at once to do. In other cases, and especially in those where the intestine itself is to be the object of investigation or operative attack—as for instance, in cases of obstruction from any cause, or in connection with supposed perforation (pathological or traumatic), in anastomosis operations, in enterostomy where a fistula is to be made, or in cases where the intestine itself is taken as a guide to one end or the other—any information of this kind, if it can be readily

obtained without additional danger to the patient, must often be of great value.

To be sure, all surgeons are familiar, in a sort of general way, with the characteristics of the upper and the lower parts of the bowel, and also know that, in an incision in the upper part of the abdomen the upper part of the bowel is most likely to be met with and in an incision in the lower part of the abdomen the lower part of the bowel. And yet it has seemed to me that a further study of the characteristics of the bowel and its mesentery at different points might enable the surgeon to localize an intestinal loop with more precision than formerly, and, at the same time, to determine which end is really the upper end of the loop and which the lower.

I have, therefore, during the past six months made a number of investigations on the dead body, with the idea of determining whether there were any points which would be of real assistance in this matter. I have tried to conduct these examinations on autopsied subjects, so far as conditions would allow, so that the tissues might be as nearly fresh and normal as possible. I have also used a number of cadavers in the dissecting-room at the Harvard Medical School. (I wish to acknowledge the kindness of Dr. Mallory at the Boston City Hospital and of Drs. Dwight and C. B. Porter at the Harvard Medical School, who, for the purpose of these investigations, placed a large amount of material at my disposal.)

In some of the cadavers I examined the intestine and mesentery only for the purpose of familiarizing myself with their different parts, making careful note of such points as I thought might be of use in the matter of intestinal localization. I wished not only to verify for myself the general description of the parts as given in the books, but also to get any further information which a special study of them on the cadaver might furnish. I then tested the value of all the information thus acquired through various abdominal incisions in other cadavers. The number of cadavers used for both these purposes was about forty. In all this work thin rubber gloves were worn, not only for the sake of protecting the

hands, but also for the purpose of simulating, so far as the sense of touch was concerned, actual operative conditions.

(a) *Actual tests in localization of loops of intestine.*

At first I did most of this work alone, but later was assisted by Mr. Everett Lee, a fourth-year student at the Harvard Medical School, who made a number of useful suggestions in the course of the work.

Tests were made through various abdominal incisions on sixteen different cadavers. Through each wound a loop of intestine was pulled out, and its characteristics noted. It was then localized by means of these characteristics, the direction determined, a tag attached bearing a number, and dropped back again into the abdominal cavity. Another loop was pulled through the wound, and the same process repeated. Sometimes a number of loops, one after the other, were pulled through one incision, and at other times several incisions were made and a different loop pulled through each of them, each loop being, in every case, localized and tagged before it was dropped back into the abdominal cavity and before another loop was pulled out. A written record was kept of the estimated position of each numbered loop—that is to say, its supposed distance from the upper or lower end. Later the abdominal cavity was laid open, from ensiform cartilage to symphysis pubis, and the whole intestine measured carefully *in situ* by means of a tape measure, starting from the end of the duodenum. The actual distances of the different tags from that point were recorded as soon as they were determined. The direction of the gut was indicated at different points by special pins, the ends of which were supposed to point, in the opinion of the examiner, to the ileocæcal valve.

I have on record 180 different localizations. These represent, however, about 125 different loops, as Mr. Lee and myself frequently localized the same loop independently of each other, such localizations on the same loop being recorded as two. The results of these 180 localization tests are given in the following table:

	Number.	
Localizations, correct	7	(about 4 per ct.)
" with error of less than 1 foot	46	(" 25 ")
" " 1 foot or more, but less than 2 feet	38	(" 21 ")
" " 2 feet " " " 3 "	45	(" 25 ")
" " 3 " " " " 4 "	16	(" 8 ")
" " 4 " " " " 5 "	15	(" 8 ")
" " 5 " " " " 6 "	7	(" 4 ")
" " 6 " " " " 7 "	5	(" 3 ")
" with still greater error	1	(" 0.5 ")
Total number of localization tests	180	

The average error in the 180 tests was 2.08 + feet.

Seventy-five per cent. of all the localizations were, therefore, made with errors of less than three feet. In the early stages of this study, before all the determining factors could be made use of, the errors were more marked than later, when the tests showed a distinct improvement in this respect.

The following record is given as a sample of localization. The cadaver was that of a well-developed man, about fifty years of age. An incision was made in the median line, between the umbilicus and pubes. The hand was introduced into the abdominal cavity, and ten different loops from ten different regions pulled through the wound one after the other, each one, however, being localized (as to its distance from the end of the duodenum), tagged, and returned into the cavity before another one was drawn out.

Loop.	*Localization.*	*Actual site.*	*Errors.*
1	6 ft.	3 ft. 10 in.	2 ft. 2 in.
2	18 "	22 " 6 "	4 " 6 "
3	10 "	8 " 9 "	1 " 3 "
4	14 "	14 " 3 "	3 "
5	16 "	12 " 1 "	3 " 11 "
6	17 "	20 " 4 "	3 " 4 "
7	8 "	7 " 4 "	8 "
8	3 "	10 "	2 " 2 "
9	18 "	18 " 5 "	5 "
10	4 "	3 " 2 "	10 "
Estimated length of intestine			21 "
Actual length of intestine			22 " 9 "
Total errors			19 " 6 "
Average error (about)			2 "

I could give records showing much closer estimates and others showing much worse. On the whole, this record is about an average one.

In this cadaver work I have used, principally, actual measure-

ments from one end or the other, for the sake of greater accuracy in localization and for the purpose of comparing results. One may use, equally well, proportions such as "thirds," "quarters" or "fifths." Thus, one may say that such and such a loop occupies the upper or lower part of the upper, middle, or lower third, or that it is about so and so far from one end or the other, or from the middle point of the gut. Obviously, any method may be used in indicating the site of a given loop, provided it is sufficiently accurate for the purpose in hand.

It will, perhaps, appear strange that I have, thus far at least, made no mention of the terms "jejunum" and "ileum." My reason for this is that, as we all know, there is no dividing line between them. In fact, although the jejunum is usually described in the text-books (*e.g.*, Quain) as being the upper two-fifths and the ileum the lower three-fifths, some German anatomists (*e.g.*, Merkel) speak of the upper three-fifths as jejunum and the lower two-fifths as ileum. The middle one-fifth is, therefore, jejunum or ileum, according to the anatomical authority one prefers to follow. These terms, however, are so firmly rooted that they will probably always be used by surgeons, but they can never mean anything more than to convey a very general idea as to position, for the term "jejunum" merely means the upper part of the bowel, and the term "ileum" the lower part of it.

(b) *Actual tests in the determination of direction in given loops of intestine.*

The attempt to determine the direction of the gut was made in ninety different loops in fifteen different cadavers. In eight the direction proved to be wrong; in eighty-two (or 91 per cent.) it was right.

(c) *Characteristics (anatomical and otherwise) of the small intestine, which may be used on the cadaver for determining the position and direction of any given loop of intestine.*

I may as well state here my regret that I have been able to find no infallible characteristic sign to indicate any one particular point of the bowel, except at the two ends where the bowel is fixed.

Almost all the characteristics of the different parts of the intestine undergo changes as we pass to other parts of it, and even these transitions vary with the individual. The changes are usually gradual, and not abrupt, and for this reason we cannot say that a change takes place at such and such a point. This makes localization difficult enough; but when we realize that a bowel (I refer only to that part of it which has a mesentery—*i. e.*, from the end of the duodenum down) may be anywhere from fifteen feet to thirty feet in length, and that, before our incision, we have no means whatever of knowing what this length will be, our problem becomes enormously complicated. And yet, when we have so many things to help us—even if none of them are positively distinctive—we may be able to localize a loop near enough for practical purposes by a combination of them. A knowledge of these various combinations means, of course, a certain amount of practice and experience, though not so much as one would suppose.

1. *What part of the small intestine may we expect to meet in any one of the various abdominal incisions?* This naturally brings up the subject of the disposition of the intestine in the various regions of the abdominal cavity. The studies of Treves,[1] Henke,[2] Sernoff,[3] Weinberg,[4] and Mall[5] are exhaustive and valuable from an anatomical standpoint, but in the way of assisting the surgeon in practical work they have not very much to offer. Generally speaking, however, it is well to bear in mind that Mall, in a systematic examination of the arrangement of the mesenteric loops in forty-one cadavers, found what he called a normal arrangement in twenty-one of them. By consulting his diagram it will be seen that in this normal arrangement the principal sweeps of the mesentery are first to the left, then to the right, then to the left iliac region, and,

[1] Three Lectures on the Anatomy of the Intestinal Canal and Peritoneum. British Medical Journal, February 28, 1885, p. 415 et seq.

[2] His, Archiv., 1891.

[3] Zur Kenntniss der Lage und Form des mesenterialen Theiles des Dünndarmes und seines Gekröses. Internat. Monatschr. f. Anat. und Physiologie, Band xi., 1894.

[4] Internat. Monatschr. f. Anat. und Physiologie, Band xiii., 1896.

[5] Development of the Human Intestine and its Position in the Adult. Bulletin Johns Hopkins Hospital, 1898. vol. ix. p. 197.

finally, into the pelvis and up again to the ileocæcal valve. There are, however, many variations from this normal standard. When one realizes the extreme mobility of the small intestines one is not surprised to see with what ease they may be pushed to any part of the abdomen, and to this fact, more, perhaps, than to any other, is to be attributed the different positions in which the same coils are found in different cadavers. While the different coils may have in the same body their favorite places of rest, it is evident that they are easily changed by change of posture of the individual or as a result of pressure applied from one direction or another. Tumors may push the intestines to any part of the abdominal cavity. An enlarged stomach may push them all into the pelvis, and an enlarged colon may press them to one side or the other. In one cadaver with ascites I found, as one would expect, that there were no coils at the back of the abdominal cavity or in the pelvis. Dr. Mixter tells me of a case of his in which, on opening the abdominal cavity, he found that most of the small intestine had passed upward into the pleural cavity through a rent in the diaphragm. I have noticed in a few cadavers, where there was great emaciation and where the abdominal wall was represented by a concavity instead of a convexity, that most of the small intestines were in the pelvis.

As I shall, from time to time, refer to the root of the mesentery for various points in this paper, and as its position has something to do with the arrangement of the various intestinal loops, I insert here a brief description of it:

The mesentery springs from the posterior wall of the abdomen along a straight line six inches in length, which starts above on the left side of the spinal column at the point where the duodenum ends, about on a level with the body of the second lumbar vertebra, and is continued obliquely downward and to the right, to end in an indefinite way at a point about opposite the sacro-iliac synchondrosis. I have been able to find no very satisfactory illustrations to demonstrate this mesenteric root, and have, therefore, devised a method of my own, which I think, for the purposes of this paper at least, will show it very satisfactorily. This method has the

additional advantage of simplifying the intestinal tube by causing it to conform to a straight line (see Fig. 1).

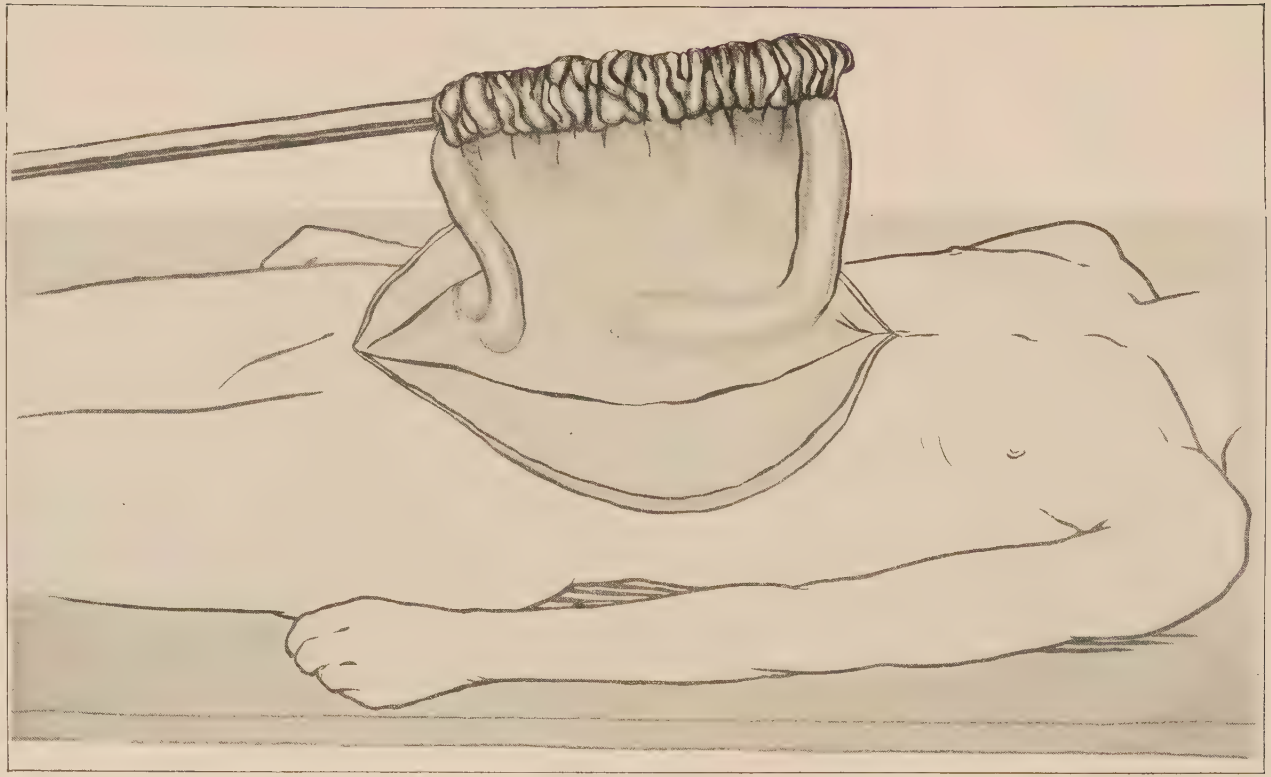
A rod has been pushed into the intestine through an opening in the gut, about six to eight inches above the ileocæcal valve, and the entire intestine, barring the upper and lower few inches, is drawn over its tip and puckered up on the rod in exactly the same way that an earth-worm is put upon a hook. Two ligatures are then placed on the ends, and it is found that, without using undue force, the twenty feet of intestine, more or less, can be made to occupy a space of not more than one foot in length.[1] When the intestine is held up on the rod, and placed so that the axis of the rod is parallel with the axis of the oblique line of the mesenteric root, the mesentery may be inspected with great ease. Looked at in this way, the mesentery forms a sort of partition, as it were, with the puckered intestine fringing its upper edge. It thus divides the abdominal cavity into two large fossæ, of which the left is much the larger (see Figs. 2 and 3).

The correspondence between the different parts of the small intestine and the oblique attachment of the mesentery is made evident here, and it becomes more obvious why the upper part of the intestine would be most apt to occupy the upper part of the abdomen and the lower part of the intestine the lower part of the abdomen.

I have found that, in normal conditions, the upper six feet or so of the tube is generally confined to the left hypochondriac region, occupying a deep fossa there under the ribs, and in such a position that its coils would not usually be encountered through any of the ordinary abdominal incisions. The middle part of the intestine

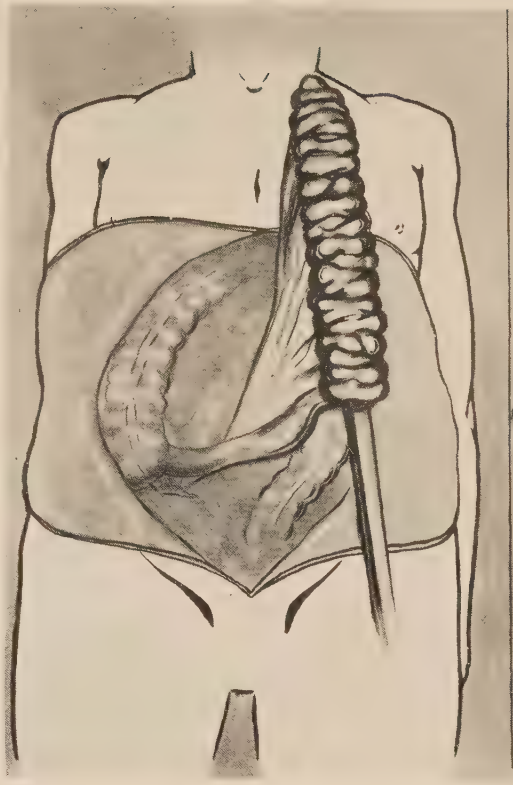
[1] It is astonishing with what ease this can be done when the abdominal cavity has been freely laid open. In fact, so readily is it accomplished under these conditions as to suggest the possibility of introducing into the gut (when freely exposed in an operation) a rigid tube for purposes of inspection of the inside of the gut or for the removal of gas or other intestinal contents. The tube cannot be pushed into the gut, but the gut must be pulled up over the end of the tube. To what extent the mechanical part of this procedure can be accomplished on the living subject through an ordinary abdominal wound may be easily determined on the cadaver. It is, of course, uncertain to what extent the shock and danger of infection, in connection with such a procedure, would prevent its use.

FIG. 1.



Showing the small intestine puckered upon a rod. (Drawn from a photograph.)

FIG. 2.



Showing the right fossa of the abdominal cavity and the oblique attachment of the mesentery. (Drawn from a photograph.)

FIG. 3.

Showing the left fossa of the abdominal cavity and the oblique attachment of the mesentery. (Drawn from a photograph.)

FIG. 4. Showing approximately the line of the mesenteric root as traced on the abdominal wall.

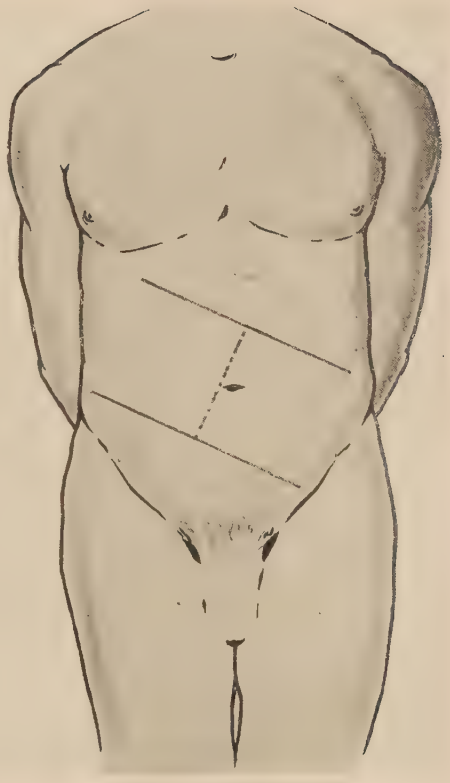


FIG. 5. Showing the two oblique lines (black) drawn at right-angles to the two extremities of the line (dotted) of the mesenteric root. The upper, middle, and lower compartments here indicated contain in most cases the upper, middle, and lower thirds of the small intestine respectively.

usually occupies the middle parts of the abdomen, while the lower part of the tube is generally in the pelvis and in the right iliac fossa. In order to roughly indicate on the outside of the body the positions ordinarily occupied by the upper, middle, and lower thirds of the intestine, I have found that two straight lines running obliquely across the abdomen at the two ends of and at right angles with the line of the mesenteric root will divide the abdomen into three regions, each of which will contain in most bodies about one-third of the intestinal tube, the upper third being in the first region, the middle third in the second region, and the lower (or third) third in the third region, as shown in the diagrams (see Figs. 4 and 5).

It will thus be seen that an incision anywhere above the first line will probably disclose loops belonging to (or near) the upper third of the intestine; anywhere between the first and second lines, loops belonging to the middle third, and anywhere below the second line, loops belonging to the lower third. This appears to be a pretty good general rule in intestinal topography, to assist us in determining, while making our incision, what part of the bowel we are likely to meet with first. We should not forget, however, that there are occasional and marked exceptions to this rule.

2. *The length of the intestine.* There seems to be no relation whatever between the length of the intestine and the age or sex of the individual. So far as I know, all who have written on the subject bear witness to this. Therefore, we have no means of knowing, before we make our incision, whether we are to meet a long, a short, or a medium intestine. Treves attributes these variations to physiological influences, and this explanation, though somewhat vague, has been pretty generally accepted by those who have investigated the subject. It is not at all clear why there should be such great variations in the length of the tube in different individuals. Of the subjects examined by me the shortest intestine was fifteen feet, and the longest twenty-nine feet, the average being about twenty-one feet. Almost all the measurements were made *in situ* with the aid of a tape measure.

I have recently noticed in three or four cases where the intestine

was very long that the mesentery was also of unusual length, and that the vasa recta (or the little straight vessels running from the mesenteric loops to the intestine) were much longer than the average. I have also noticed in a few cases where the intestine was short that the mesentery and vasa recta were also inclined to be short. Occasionally I have been able to estimate, with some success, the approximate length of the bowel by localizing the first loop presenting, and determining—by putting the mesentery gently on the stretch and by examining the vasa recta—whether the mesentery and vasa recta were longer or shorter than the average at this part of the tube. If longer, I made an estimate that the intestine was above the average—that is, more than twenty-one feet; and if shorter, I considered that it was probably below the average, or less than twenty-one feet. This point I speak of, incidentally only, as a matter of general interest. But, having tried it in so few cases, I cannot say whether this test for determining the length of the intestine from the length of the mesentery and the vasa recta in any one loop is at all reliable.

The small intestine is described in the books as being thicker and of greater diameter in its upper than in its lower part. Other general characteristics of the different parts of the tube are occasionally alluded to.

The statements which I shall make in reference to the characteristics of the intestine and mesentery are based almost entirely upon the results of the examinations I have made on the cadaver. I should like to say, however, that on account of the extreme variability of the different characteristics of the intestine in different individuals, a larger experience may later necessitate an appreciable modification of some of these statements.

3. *The size of the intestine.* The diameter of the gut is greatest above, and gradually diminishes in size as we go down the tube. When we reach the lower third or so the size remains about the same throughout. (The size may vary so much in life, however, with contraction or distention, that, as a means of distinguishing one part of the gut from another, a knowledge of different diameters, given in actual measurements, would not be of much value.)

4. *The thickness of the intestine.* The upper part of the small intestine is normally thicker than any other part. This thickness is principally due to the presence of large and numerous valvulæ conniventes and to the great development of the muscular layers. As we pass down the tube we observe that it gradually gets thinner and thinner until we reach the lower third of the gut, where it remains about the same, thickening up again, however, in the last two or three feet.

The thickening of the lower part of the tube is presumably due to an increase in the muscular elements, the food being at this point distinctly more solid and, therefore, more difficult to force onward. In certain cases of chronic obstruction the thickness and size of the tube are greatly increased, as I have had occasion to observe recently in a case of obstruction due to cancer at the ileocæcal valve. Presumably the increased thickness in such cases is largely due to hypertrophy of the muscular walls of the gut. Great distention by gas increases the apparent size of the gut and diminishes the thickness of the walls.

5. *The color and general vascularity.* The upper part of the bowel in normal conditions is bright pink or red, and exhibits great numbers of branching vessels of good size. The color as we go from the tube gradually fades out to a gray or pinkish or yellowish-gray, and the vascularity grows less and less marked.

6. *The valvulæ conniventes.* In the upper part of the bowel the valvulæ conniventes are large and numerous. They can always be felt, and generally seen as pinkish or whitish rings, more or less complete, about the gut. They gradually diminish in number, but especially in size, as we pass down the tube, until a point is reached, which I have found to be about fourteen or fifteen feet from the end of the duodenum, beyond which they can seldom be felt or seen. Though the distance to which the valvulæ conniventes extend varies somewhat, this variation has, apparently, nothing to do with the variations in the length of the tube.

7. *Contents of intestine.* Mention is made of the contents of the intestine only for the sake of completeness. The different parts of the intestine show food in the various stages of intestinal diges-

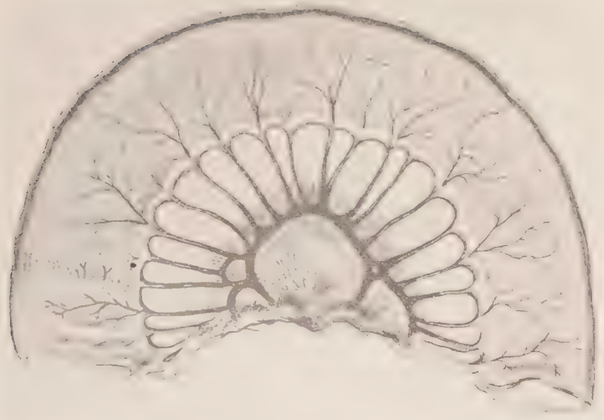
tion. The consistency increases somewhat toward the lower end of the tube.

8. *Resistance at the two ends of the bowel.* It is hardly necessary to call to mind the fact that when one end of a loop which is high up in the bowel is gently pulled upon and meets with a resistance, the loop is probably close to the duodenum; and also that, when one end of a loop low down in the bowel meets with a resistance in the ileocæcal region, the loop is probably a short distance from the valve.

9. *General vascularity of the mesentery near the bowel.* Opposite the upper part of the bowel the mesenteric vessels are distinctly larger than opposite any other part of it. These vessels grow smaller and smaller as we pass downward until the lower third of the gut is reached, where they remain about the same size as far as the ileocæcal valve. The arrangement of the mesenteric vessels has some features which intimately concern the subject in hand, and which I shall describe with some detail. Diagrammatically speaking, the main branches of the superior mesenteric artery unite with each other by means of loops, which are called for convenience "primary loops;" in some parts of the tube, "secondary loops," and even, occasionally, "tertiary loops" are superimposed upon these. From these loops little straight vessels—the vasa recta already referred to—run to the bowel, upon which they ramify, alternating, as a rule, as to the side of the intestine which they supply. The mesenteric veins are arranged in a manner somewhat similar to the arteries.

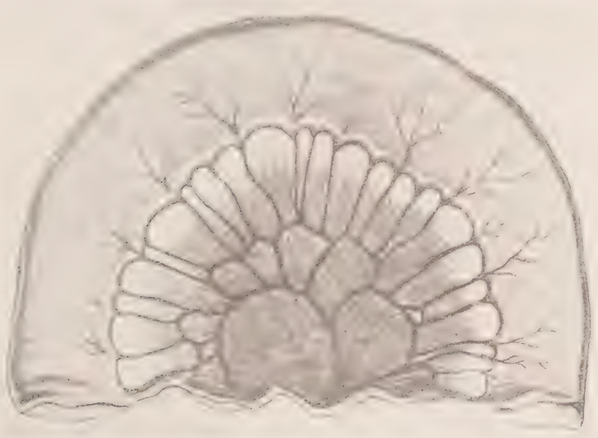
10. *The loops of the mesenteric vessels.* Opposite the upper part of the bowel there are only primary loops. Occasionally a secondary loop appears, but it is small and insignificant as compared with the primary loops, which are large and quite regular. As we proceed down the bowel secondary loops become more numerous, larger, and approach nearer to the bowel than the primary loops in the upper part. As a rule, secondary loops become a prominent feature at about the fourth foot. As we continue farther downward, the secondary loops (and, possibly, tertiary loops) become still more numerous and the primary loops smaller, the loops all

FIG. 6.



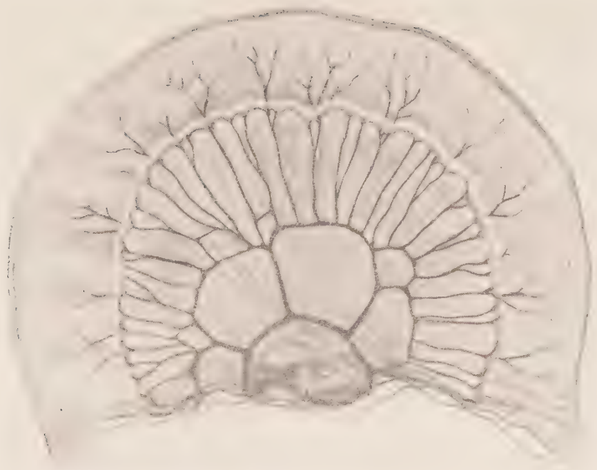
A loop of intestine, the middle of which is exactly three feet from the end of the duodenum. The gut is of large size. The mesenteric loops are primary, and the vasa recta large, long, and regular in distribution. The translucent spaces (lunettes) between the vessels are extensive. Below, the mesentery is streaked with fat. The veins, which had a distribution similar to the arteries, are for simplicity omitted from this and from the subsequent drawings. (The subject from which the specimen was taken was a male, forty years of age, with rather less than the usual amount of fat. The entire length of the intestine was twenty-three feet.)

FIG. 7.



A loop of intestine at six feet. As compared with Fig. 6, the gut is somewhat smaller; the vascularity of the intestine and mesentery is less. Secondary loops are a prominent feature. The vasa recta are shorter and smaller. The lunettes are also present, but are not so large as in Fig. 6. (The subject was a male of about thirty-five years of age, with an average amount of fat. The entire length of the intestine was twenty feet.)

FIG. 8.

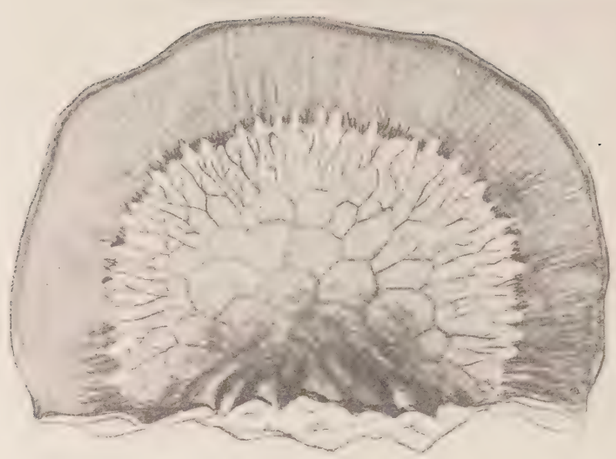


A loop of intestine at nine feet. The secondary loops are large. The vasa recta are somewhat irregular and show branches. No lunettes are present, and the mesentery is streaked with fat, and is therefore somewhat opaque. (The specimen was taken from the same subject which furnished Fig. 6.)

FIG. 9.

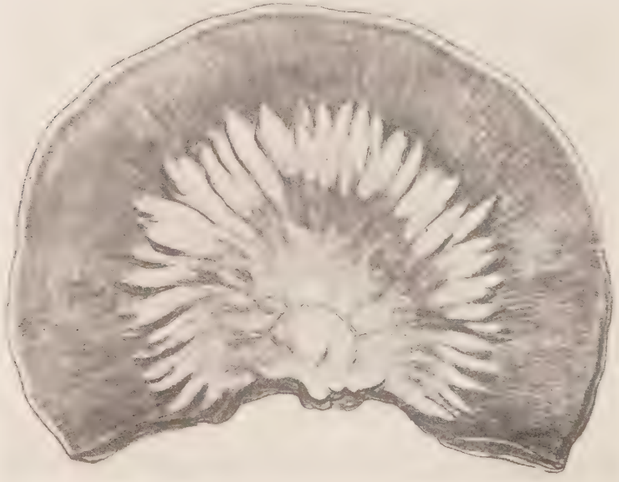
A loop of intestine at twelve feet. The vessels are smaller. The primary loops are lost in the fat, but secondary and even tertiary loops are visible. The vasa recta are shorter, more irregular, and branching. (The specimen came from the subject which furnished Figs. 6 and 8.)

FIG. 10.



A loop of intestine at seventeen feet. The mesentery is opaque, and small tabs of fa begin to appear along the mesenteric border of the gut. The vessels are represented b a somewhat complicated network, and are seen with difficulty in the thick fat of th mesentery. (The specimen came from the subject which furnished Figs. 6, 8, and 9.)

FIG. 11.



A loop of intestine at twenty feet. The gut appears to be thick and large. The mese tery is quite fat and opaque, and numerous large, fat tabs are present. The vessels, whic are complicated, are seen with difficulty, and are represented by mere grooves in the fa (The subject was a stout woman, and the entire length of the gut was twenty-one feet.)

Indeed, were it not for the fact that the patients who undergo these operations are children, whose joints recover from traumatism in an extraordinary degree, the results of such forcible manipulation would be disastrous. Another objection to the reduction by forcible manipulation is that the parts being invisible it is often impossible to determine whether the reduction is satisfactorily accomplished or not, whether shreds of the joint capsule are not caught between the bones, whether the capsule is not torn away bodily and displaced. Notwithstanding, therefore, the brilliant work of Lorenz, it is a question whether reduction by open operation has not still a place even in congenital dislocation of the hip.

These two radiographs, taken at different times of the same elbow, show very well the growth of new bone from stripped-up periosteum. The one (Fig. 1) was taken a month after operation by Trendelenburg's method of section of the olecranon for a posterior luxation of both bones nine months old.

The radiograph further shows a condition of separation of the ulna from the humerus—a subluxation—the result of imperfect fixation of the arm, reluxation having occurred during the after-treatment. On this showing the joint was again opened, and masses of firm fibrous tissue removed from the lower end of the humerus, and the wound closed. The wound healed by primary union, and the joint was kept fixed for about three weeks, when active motion was permitted.

The second radiograph (Fig. 2) was taken six months later, and shows the shadow in front of the joint far more dense and sharply outlined, indicating complete ossification. Were the joint opened at this time, this mass of bone might well enough be looked upon as a fragment of the coronoid process of the ulna displaced upward. It sharply limits flexion by impinging against the humerus, and there is little doubt that had the stripped-up periosteum been removed more thoroughly or replaced, better function would have resulted. As it is, flexion is free through an angle of about 65°, from 75° to 140°. As shown by the photograph (Fig. 3), which was made by taking two exposures on the same plate, the range of motion and the position of it makes the arm useful, as

it was not before the operation, for its range of motion was limited and it could not be flexed to a right angle. Rotation is normal.

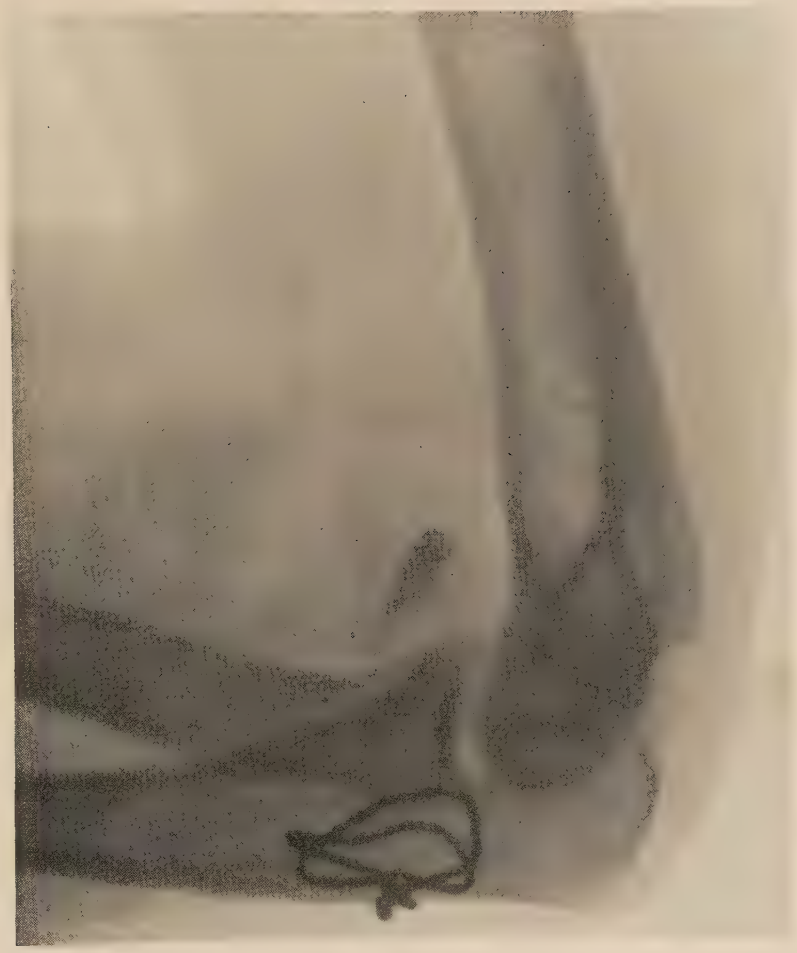
A similar photograph of a parallel case in a young woman, aged twenty-five years, operated upon seven years ago by partial resection, shows the greatly inferior result as regards function of that procedure, motion being possible only through an angle of perhaps 35°, say from 70° to 105°. Rotation is also restricted. Cosmetically, however, the appearance of the elbow is good; its outline is practically normal. The dislocation was but six weeks old, and had been put up in plaster-of-Paris for several weeks by an irregular practitioner, under the diagnosis of fracture of the lower end of the humerus. The arm was useless, being fixed at an angle of about 130°; therefore, resection was proposed. The writer first tried with moderate force to reduce without cutting, the ulna was drawn downward somewhat, but the coronoid process could not be brought beyond the summit of the trochlea. Immediate incision into the joint showed that the coronoid process had crushed deeply into the trochlea, producing a severe traumatism. This made an excellent demonstration of the futility and the risk of using force on such elbows.

The radiograph (Fig. 5) shows that the limited flexion is due to bony outgrowth from the lower end of the humerus filling up the cavity of the olecranon.

These two cases—exactly similar in pathological lesion, in age and condition of patient—add a little by way of confirmation of the principle that the results of operative reduction are better than those of resection.

As to the method to be chosen for the operation, it would seem that method is best which causes least traumatism, while permitting sufficient access to the joint to enable the operator to explore all its recesses and remove all masses of new bone and fibrous tissue. Von Eiselsberg seems not to fear complete isolation of the lower end of the humerus, cutting off the ligamentous structures on all sides; but he is careful to do the work *extraperiosteally*. Such extreme traumatism would seem to be unnecessary, and is depre-

FIG. 2.



Result six months after operative reduction.

FIG. 3.

Result six months after operative reduction.

FIG. 4.

Limited motion seven years after partial resection.

FIG. 5.

Seven years after partial resection.

cated by Luksch, of Nicoladoni's clinic,[1] on the ground of the greater danger of sepsis in complicated and extensive wounds. The other danger of the growth of new bone around the edges of the articular cartilages would also seem to be a serious objection. The operation by two lateral incisions is generally preferred. Luksch and Weber,[2] of St. Petersburg, who reports two cases with excellent result, used the simple external lateral incision or Kocher's incision for resection of the elbow.

In the case of operative reduction here reported the writer used the Kocher incision, but because of difficulty in reducing the dislocation and a fear of loosening up the periosteum, he added the procedure of Trendelenburg, of section of the olecranon. Simple flexion opened the joint widely, giving excellent access to all parts of it, nor was there any difficulty in fastening the olecranon again into place with wire, and without other injury to the extensor apparatus. Primary union occurred, and the olecranon united without deformity.

It is probable that the simple radial incision, which may be extended if required (as in Kocher's incision for resection of the elbow), will best fulfil the indications in most cases; through it all parts of the joint may be reached with a minimum of traumatism, and through it, if it be found necessary, the olecranon can be readily separated. In cases in which the periosteum or new bone is difficult of removal from the inner side of the joint, an ulnar incision may be readily added. All bleeding must be stopped, when the wound can best be closed without drainage, care being exercised to approximate corresponding parts.

It goes without saying that the Röntgen ray is of peculiarly great value in the anatomical diagnosis of such cases, not merely as establishing additional indications for operation, but as determining the exact size, shape, and position of the masses of new bone or fragments in case of fracture, thereby aiding in the completeness of the operation and insuring against any such mass being overlooked. Further, if the dislocation be not too old, so that

[1] Deut. Zeitsch. f. Chir., lvii. p. 413.
[2] Ibid., lxiv. p. 201.

ossification is complete, the Röntgen ray will differentiate between fragments and callus and new bone, and will give an accurate picture of the condition and relations of the bones forming the joint.

The results of operative reduction of dislocations of the elbow are functionally and cosmetically so satisfactory and so greatly superior to those of resection that it would seem that the operation is deserving of more prominent mention in our text-books than it has received.

DISCUSSION.

Dr. John B. Murphy, of Chicago.

As long as this is the only paper of this class, and as long as the defective motion is the principal objection, it seems to me that this is a good opportunity to speak of the application of arthroplasty in the prevention of ossification. I have had opportunity to put into effect on the living subject what I have demonstrated on the cadaver in cases of elbow ankylosis. The importance of doing arthroplasty in connection with the elbow-joint was, as I found on the cadaver, based upon using the aponeurosis of the triceps, swinging it into the joint, and bringing it completely around the articular surface of the humerus. When the elbow is restored there is placed between the articular surface of the ulna and the articular surface of the humerus the aponeurosis of the triceps muscle, keeping the pedicle attached below and drawing the flap through from the outer side of the joint. I have also used this arthroplastic method in three cases on the knee-joint, and in all of them I succeeded in overcoming the bony ankylosis, which was such a very important factor in the cases. Recently I performed the same type of operation in connection with the hip-joint, making a U-shaped flap, base upward, over the trochanter, and carrying with the flap the fascia lata and a few fibres of the gluteal muscles. I laid the hip-joint open by first passing the chain saw behind the trochanter, sawing it off with its muscles attached, displacing the flap upward. The head of the femur was then chiselled free in the fossa with a curved chisel (one and a half inch radius) by a rotatory motion; the head was thrown out of the acetabulum and the cavity smoothed and enlarged with a bone curette; the head was smoothed preparatory to returning it into the acetabulum. The acetabulum was protected by dissecting the fascia lata free from the flap, with pedicle above. The cavity of the joint was then lined with the flap, and it was sewed up around the neck. I then fastened the head of the femur in the acetabulum by suturing the capsule, and the joint looked quite normal. From the fact that, even after suppuration, we have obtained a movable joint in all three of the previous cases, and thus prevented bony union, I feel that in all of these cases we should endeavor to secure this result by the interposition of the aponeurosis of the muscle in the neighborhood.

June 22d. Excellent motion is secured in the hip case cited above.

Dr. Alex. Hugh Ferguson, of Chicago.

I rise to support Dr. Murphy in what he has said. In two cases of the elbow-joint I have successfully introduced a portion of the supinator

longus muscle to prevent ankylosis. In another case—a knee-joint affected with tuberculosis fibrosa in a boy, aged six years—after performing an atypical resection I brought up the posterior ligament as a diaphragm between the two bones, and ankylosis was thereby prevented.

THE PATHOLOGY AND TREATMENT OF TARDY POSTOPERATIVE INTESTINAL OBSTRUCTION, WITH A REPORT OF CASES.

By ELLSWORTH ELIOT, Jr., M.D.,
NEW YORK CITY.

Acute obstruction following laparotomy is not a rare occurrence. It is most frequently the result of paralysis of peristaltic activity from a spreading or septic peritonitis. It occurs less frequently after a laparotomy from a non-purulent condition, even although no infectious material has been introduced at the time of operation. In this latter group of cases the obstruction is usually of a mechanical nature, and is due to the the angular adhesion of one or more loops of intestine to the parietal peritoneum, to each other, or to the stump of some recently ligated pedicle of omentum or ligated base of tumor, to a possible volvulus, or to the protrusion of a coil of intestine through some accidental orifice in the mesentery or other peritoneal structure.

In all of these conditions the symptoms indicating obstruction develop shortly after the operation, and usually before satisfactory restoration of the intestinal function has taken place. On the other hand, "tardy" intestinal obstruction following operation refers to those cases in which an interval of weeks, months, or even years elapses before the symptoms of obstruction appear—an interval in which the patient enjoys excellent health, and in which there is no irregularity in the movement of the bowel. In this group of cases the cause of the obstruction is always of a mechanical nature, the lumen of the intestine being gradually narrowed by the contraction of a circumferential cicatrix within its wall, or by the constriction of a band without, beneath which the intestine has

accidentally passed and subsequent extrication has proved impossible. In other cases the stricture is due to the progressive kinking of a segment of intestine from the contraction of adhesions of organized connective tissues joining together at an angle those loops of which the segment is composed. In many cases several of these conditions coexist.

Apart from the particular form of constriction, there is little variety in the lesion. The gross changes comprise one or more bands of connective tissue, in the formation of which the great omentum is a very frequent and important factor. These bands are attached to some fixed point on the patient's peritoneum or to some fixed or movable viscus. In this way it forms a portion of the boundary of a small aperture, beneath which a loop of intestine becomes imprisoned and subjected to such constriction that, in the absence of relief, necrosis is inevitable.

The adhesions between adjacent loops of intestine are formed of similar tissue, of such a firm character that the mass of intestine can be disentangled only with considerable difficulty, and only by the generous use of forceps and scissors.

Stricture due to the contraction of a circumferential scar in the wall of the intestine is of the simple non-malignant variety, and presents the usual features of that condition. To the outer surface of the stricture the omentum and one or more loops of intestine are usually adherent.

Other pathological changes may be associated with those directly responsible for the obstruction; thus adhesions and bands in more or less remote parts of the abdominal cavity are not infrequent, and, in addition, the lesions—such as those of a chronic tuberculous peritonitis, for the relief of which the original laparotomy was performed—may coexist.

Without interference the constriction leads to necrosis or perforation of the wall of the affected gut, with subsequent spreading peritonitis, a condition so well recognized as to require no further description.

The symptoms indicating obstruction develop either slowly or gradually. In the former group of cases occasional attacks of

constipation, which are not sufficiently marked to attract the attention of the patient, with or without colicky pain, occur irregularly during a period of several months prior to the final attack of obstruction; in the latter group symptoms indicating serious obstruction appear without warning or premonition of any kind. In both the obstruction proper runs a rapid course.

The treatment is prophylactic in that, by observing certain precautions and by a careful attention to detail and technique, both during and directly after the primary operation, the danger of the formation of permanent adhesions is very largely minimized. The treatment of the attack of the obstruction proper does not differ materially from the treatment of acute obstruction from any cause.

Prophylactic measures at the time of the original laparotomy include the careful exclusion of any kind of mechanical, thermal, or chemical irritation from the contents of the abdomen. Thus the utmost gentleness should be observed in the necessary manipulation of intestine and every precaution taken to avert the accidental catching of a loop with the edge of a retractor. The use of too hot saline fluid or of germicidal solutions containing some chemically irritant or caustic ingredient, such as bichloride of mercury, for purpose of irrigation, damages the visceral peritoneum, and should be carefully avoided.

All ligatures, by acting as foreign bodies, are sources of mechanical irritation, and should, therefore, not be needlessly applied. Thus many adhesions, the result of previous localized peritonitis, may be divided without fear of hemorrhage; on the other hand, the pedicles of tumors or bands connecting these with the adjacent parietal peritoneum frequently contain large bloodvessels requiring ligature, the irritant effect of which, however, can be diminished by the use of catgut rather than of silk. Another frequent cause in the production of chronic peritoneal adhesions is the presence of denuded stumps, such as those of an amputated appendix or of the uterus and broad ligaments after a supravaginal hysterectomy. To obviate, as far as possible, band formation from this cause, the surgeon endeavors, prior to the closure of the abdomen, to cover

all stumps with a smooth peritoneal investment. In the amputated appendix this is accomplished by a purse-string suture around its base; in hysterectomy, by covering the uterine stump with a flap of peritoneum and by drawing together with Lembert sutures the parietal peritoneum on either side of the ligated broad ligament. In addition to these precautions, lines of suture may be covered (when feasible) with omentum, the adhesions which develop between such suture lines and omentum being preferable to angular adhesions of loops of intestine to each other.

Unfortunately, however, in certain laparotomies, the separation of extensive adhesions involving the parietal peritoneum, the mesentery, and the hollow viscera exposes denuded areas so large that their investment with peritoneum proves impossible. In these cases an effort may be made to diminish the almost certain probability of band formation by covering the exposed area with a segment of very thin rubber tissue or of cargile membrane. Sufficient time has not yet elapsed to permit of an accurate estimate of the efficacy of this procedure in the human subject. The writer has observed in several instances partial displacement of pieces of cargile membrane from the wall of intestine, due to the friction associated with the return of the affected loop into the abdominal cavity. Such displacement may be prevented in the case of rubber tissue by the passage of several sutures between it and the edge of the denuded area.

The management of drainage is an all-important factor. The use of a drain in almost all laparotomies for abscess formation is indispensable; its presence, nevertheless, is disadvantageous in that it favors band formation. Occasional exceptions are, however, noted from time to time in those cases in which, a second laparotomy being necessary, the adhesions observed at the time of the primary operation have either become insignificant or have entirely disappeared.

Notwithstanding occasional immunity from this danger, therefore, band formation after the use of drains to such an extent as to prove a future source of trouble is a distinct probability. The risk so incurred may be minimized by using as small an amount of

drainage material as is consistent with the patient's safety, and, in the event of a capillary gauze drain, by enveloping the same in a cylinder or sheath of sterilized rubber tissue.

Furthermore, the early change of the drain, with subsequent diminution of its bulk when it must be replaced, and, in certain cases, its early complete removal, render the formation of permanent adhesions less likely.

The immediate postoperative treatment consists in establishing, at the earliest possible moment, normal or preferably exaggerated peristaltic activity. During the first twenty-four hours, when the stomach is in an unsettled condition, the restoration of that function is favored by the use of rectal enemas of warm saline solution, with or without turpentine, and, in cases of persistent vomiting, by lavage. As soon as the nausea and vomiting subside, small doses of calomel and salts should be administered and movements favored by high turpentine injections. These measures avert, to a certain extent, not only the adhesion of intestinal loops, but, also, by the removal of all fermenting material, the development of adhesions from possible chemical irritation of toxic substances as they are absorbed by the intestinal wall, is very largely prevented.

The formation of adhesions is still further probably decreased by frequent changes in the position of the patient. This can preferably be accomplished by alternately raising and lowering the head or foot or sides of the bed. In this way, without discomfort to the patient, the mobile contents of the abdomen may be directed to different parts of the cavity through the action of gravity.

These various measures are not cited as a part of the routine treatment of every laparotomy, but only when, after an extensive or infectious peritonitis, or after operations involving suture of the intestinal loops, or after operation for the relief of obstruction due to bands, subsequent band formation is to be apprehended.

The actual treatment of the obstruction proper does not differ essentially from the treatment of obstruction from any cause. Early laparotomy, the ligation and removal of constricting bands, the disentanglement of adherent intestine with resection (in those cases in which the loops are so firmly bound together that their

separation is impossible, or in those cases in which the affected intestine has become necrotic), subsequent closure of the abdomen with or without drainage, together with the adoption of those measures already described for the prevention, if possible, of subsequent adhesions, comprise the general routine treatment in these cases.

Case I. *Laparotomy for gangrenous appendicitis complicated with general septic peritonitis; recovery; acute obstruction seven weeks later; operation on the fifth day; death.*—G. L., aged twenty years. With the exception of two attacks of catarrhal appendicitis during the past two years, patient has always enjoyed excellent health.

About ten days before the patient was seen by the writer the present attack began, the invasion being marked by severe pain, at first in the vicinity of the umbilicus; afterward referred to the right iliac fossa. During the first forty-eight hours there was vomiting and constipation, the latter yielding to catharsis. The pulse was at no time over 90 nor the temperature over 100° F.

An examination by the attending physician showed general rigidity of the abdomen, most pronounced in the right lower quadrant, and tenderness on pressure.

These symptoms continued for about one week, when the vomiting, which had previously subsided, recurred and became fecal, the constipation absolute, with the pulse increasing gradually to 120 and the temperature to 102° F. At the end of that time an examination for the first time by the writer revealed a firm board-like abdomen without marked distention. There was slight dulness in the lower right quadrant. There was almost complete absence of peristaltic activity. Pulse varied between 130 and 140. General condition was apathetic.

Operation. Ether: The appendix was exposed through the usual intermuscular incision. It was deeply situated, overhanging into the cavity of the true pelvis. It was gangrenous, and surrounded by a small quantity of very foul-smelling pus. There was a perforation near the tip. The cæcum and adjacent coils of small intestine were distended, of a dark-red color, injected, and in places were cov-

ered with masses of fibrin. The pelvis and the lower half of the abdominal cavity were irrigated through a secondary incision in the median line below the umbilicus with warm saline solution. Rubber tube drains, surrounded with iodoform gauze, were introduced through both incisions, converging into the bottom of the pelvis. Bandage.

For twenty-four hours after the operation patient's condition was very critical, the pulse ranging as high as 150 and of poor quality. The fecal vomiting ceased immediately, however, and twenty-four hours after the bowels moved to an enema. The temperature, never higher than 103° F., became normal at about the tenth day, and the pulse during the third week. Both incisions closed by granulation, and were completely healed at the end of the fifth week.

I am greatly indebted to Dr. James E. Moore for the following notes of the subsequent obstruction:

About seven weeks after the primary operation complete constipation developed, with symptoms of obstruction. A large dose of calomel and castor oil was immediately vomited. At the end of four days Dr. Moore was called in consultation by the attending physician, and advised immediate operation. The abdomen then had become moderately tense and distended.

The peritoneal cavity was opened by an incision along the outer border of the right rectus, disclosing extensive adhesions in every direction, especially in the right lower quadrant.

The bowel was greatly distended and rather dark colored above a band in the upper right quadrant, being collapsed below the point of constriction. With the division of the band the collapsed portion became gradually distended, but only for a short distance, when another band was encountered which produced very deep constriction. At least five strong bands and several smaller ones were divided, and then the intestine was returned into the abdominal cavity and the wound sutured. The patient's general condition was as good after the operation as before. On the third day the bowels moved after a dose of castor oil and rhubarb, but on the following day the patient gradually grew weaker and died.

Case II.—P. M., aged nine years (October 24, 1901). This afternoon, at about two o'clock, patient was knocked down by a cable car. Patient did not become unconscious, and complained of pain in the right wrist and hand, the head, and the left side of the abdomen. There was pallor and profuse perspiration, and the patient was brought to the hospital in considerable shock. One hour after admission patient vomited green fluid, several attacks occurring in the course of the next two hours. During this time there were several attacks of colicky pain in the abdomen, and the condition of shock continued.

On examination the upper two-thirds of the left side of the abdomen was tender and rigid. There was a point of maximum tenderness three inches to the left side of the umbilicus. No mass could be detected. The patient lay on the left side, and could not move toward the right without great pain. There was some dulness in the right flank; the left thigh was flexed; the pulse was slightly above 130; the rectal temperature about 100° F. Six hours after the accident the abdominal tenderness had become more marked, and the rigidity had extended over a greater segment of the abdominal wall. There was no improvement of the shock.

Operation eight hours after the accident; gas and ether. The peritoneal cavity was opened by a five-inch incision along the outer border of the left rectus, above the level of the umbilicus. It contained turbid serum with intestinal contents. A rupture was found in a coil of small intestine, involving one-third of its circumference. It was closed with a Czerny-Lembert suture. The adjacent coils of small intestine were injected and carefully cleansed with hot salt solution; also the pelvis, which contained a considerable amount of partially digested intestinal matter. Drainage of the pelvis, with partial closure of the abdominal wound.

On the first day after the operation the pulse was as high as 144, the temperature 102° F. On the third day the pulse had decreased to 100 and the temperature to 99½° F. Both became normal on the sixth day. For forty-eight hours after the operation there was a moderate amount of vomiting; bowels moved after enema on the

second day. The abdominal incision had completely closed by the twenty-sixth day.

On January 16, 1901, the ventral hernia resulting from the primary operation was closed. In the course of the operation the omentum and loops of intestine were found to be adherent to the edge of the hernial orifice, and were separated before the sutures were inserted. The patient made an uneventful recovery.

May 13th. Patient entirely well since last note until four days ago. At that time, after a hearty lunch, severe cramp, like abdominal pain, developed, with vomiting and complete constipation. The vomiting at the time of admission to the hospital had become fecal.

On examination there was moderate distention, especially in the upper part of the abdomen; there was slight general rigidity; the vomitus was brown and of a fecal odor; the patient was in a condition of collapse—pulse 120, temperature 100° F.

Operation. Gas and ether. The peritoneal cavity was opened by a median incision below the umbilicus; the small intestine was deeply constricted by an omental band near the posterior wall. Above this point it was greatly distended, and below it was markedly collapsed. The division of the band was not followed by a return of the constricted portion to its original dimensions. It remained deeply indented, and its wall seemed thickened from the deposit of connective tissue. No intestinal contents could be forced through. The loops of small intestine directly above and below the stricture were joined by a lateral anastomosis. Closure of the abdominal wound.

After the operation the temperature rose steadily to 105° F., the pulse to 190, and death took place seven hours afterward.

Case III.—K. L. S., aged forty-six years. Patient was operated on in the Presbyterian Hospital for a fibrocystic tumor of the uterus, October 10, 1899, by Dr. C. K. Briddon. Owing to the density of the adhesions, portions of the cyst wall adherent to the intestine were left behind at the conclusion of the operation. After the insertion of a gauze drain into the pelvis the remainder of the abdominal incision was closed. There was some suppuration during convalescence.

Patient was readmitted November 1, 1901. Four days before admission, after lifting a heavy weight, patient was seized with severe abdominal pain and vomiting, which has persisted and become fecal. The constipation has been absolute, with the exception of one slight movement following an enema on the first day after the attack began. Since then there has been no discharge of fecal material or flatus. There has been marked prostration.

On examination the abdomen is prominent, especially in the lower, right, and median zones. There is slight rigidity and tenderness over the tumefaction. Deep palpation under an anæsthetic elicits a soft, movable, and slightly elastic mass. Vaginal and rectal examination negative. On admission temperature is 100° F., pulse 132 and weak. Patient is in a condition of severe collapse.

Under ether a median incision was made through the old scar, and the peritoneal cavity opened. After the sponging away of free bloody fluid, the intestine presented a greatly distended condition, and was of a dark purple color. Just above the ileocæcal junction the small intestine passed beneath a band, by which it was tightly constricted, the intestine below being collapsed. The ligation and division of the band was followed by the gradual filling of the intestine below. No other constriction was found. The band seemed to pass from the mesentery over the intestine to the posterior parietal peritoneum, and had no connection with any of the pelvic organs.

The abdominal cavity was washed out with warm saline solution and closed quickly with sutures through the entire thickness of the wall, as the general condition of the patient was rapidly becoming weaker. Notwithstanding lavage and infusions, the collapse became more marked, and death occurred thirty-six hours after the operation.

Case IV. *Acute obstruction from constriction of a Meckel diverticulum; laparotomy; recovery; death six months later from some form of obstruction.*—J. R., aged nine years. Admitted to the hospital April 4, 1902. On the day before admission patient was seized with severe colicky abdominal pains about the umbilicus. There was vomiting from the very beginning, repeated at

intervals of fifteen minutes during the night. Two enemas were given without any result and without bringing away any flatus. There was considerable prostration. One week before admission patient fell, striking abdomen against the edge of a table, the accident being followed by slight pain of short duration.

On examination the abdomen is generally distended, the left flank projecting slightly more than the right. There is slight tenderness all over, but no distinct rigidity. No mass can be felt. There is some dulness in the left flank, shifting with the change in the patient's position. Peristalsis can seldom be heard, and is very faint. The pulse is 104, respiration 34, and temperature 98.6° F. There are 12,000 leucocytes.

Ether: The peritoneal cavity was opened by a median incision about four inches long beneath the umbilicus. It contained a moderate amount of clear serous fluid. To the right of the median line, at a point just above the umbilicus, a loop of small intestine has become caught beneath a Meckel diverticulum, which still remained attached to the umbilicus by a firm fibrous cord. This was excised, the diverticulum removed, and the stump closed with a catgut suture and thoroughly cauterized. The abdominal cavity was irrigated with a warm saline solution, and the wound closed without drainage.

After the operation there was moderate nausea and vomiting, the latter persisting to the fortieth hour, and then yielding to lavage. There was slight abdominal distention during the same period, with restlessness, and the pulse varied between 100 and 120, the temperature ranging around 101° F. On the third day after operation a moderate amount of abdominal pain still persisted. This rapidly disappeared when flatus was expelled, and shortly after the bowels moved after enema. Primary union was secured, and the remainder of convalescence was uneventful. Six months afterward the patient is said to have died, at some place out of town, with symptoms of obstruction.

Case V. *Chronic intestinal obstruction following operation for suppurative appendicitis.*—J. B., aged twenty-nine years. Admitted to the Presbyterian Hospital June 10, 1902. Two years ago

patient was operated upon in Germany for a suppurative appendicitis, with subsequent drainage. Patient was in bed for four months after operation. Since that time the bowels have always been constipated, more especially during the past six months, and for the past two weeks patient has been troubled with constant severe pain in and above the upper extremity of the old scar. Two days ago, while lifting a barrel, a swelling the size of a small orange, appeared in the cicatrix, which disappeared spontaneously in about ten minutes. Shortly after this there were occasional attacks of vomiting, which persisted up to the time of admission. During the past forty-eight hours there has been no movement of the bowels. On admission the pulse is 80, the temperature 100° F., and patient complains of considerable pain. An enema was followed by a satisfactory movement of the bowels.

On examination there is an old scar, about four inches long, over the site of the appendix, between the anterior superior spine and the umbilicus. There is no distention. There is a distinct area of resistance between the upper edge of the scar and the umbilicus, about the size of an egg, and this area is tender on deep pressure.

Repeated examinations of the blood never showed a leucocytosis higher than 9000.

The patient was placed in bed and the diet regulated. The pain, however, and the local resistance persisted, notwithstanding regular movements of the bowels.

June 20th. Operation. Ether: The scar was excised by means of an elliptical incision, which was deepened along the edge of the cicatricial tissue until the peritoneum was opened. The cæcum presented adherent to the parietal peritoneum, and from the end of the anterior fibrous band the stump of the appendix, about an inch in length, extended up and inward to a point on the parietal peritoneum, where it was closely adherent. In the aperture so formed a loop of small intestine had become imprisoned, and was moderately constricted. The adhesion was divided, the appendix amputated, and the intestine released. The stump of the appendix was buried with a purse-string suture of catgut, and the muscular and

aponeurotic planes of the abdominal wall were approximated with chronic sutures without drainage. Primary union was secured, the convalescence being uneventful.

Case VI. *Acute obstruction following a previous internal operation for appendicitis; recovery.*—D. W., aged twenty-two years. On May 16, 1902, patient was operated on by the intermuscular incision for appendicitis. The distal end of the appendix was atrophied and adherent to the iliac fossa. There was no pus. Its removal was accomplished without difficulty, and the wound was closed without drainage, primary union being secured, and the patient leaving the hospital in three weeks. The stump of the appendix was tied with heavy catgut and cauterized. No attempt was made to bury it with a purse-string suture.

Patient remained well until October 1, 1902. In the interval there had been occasional attacks of pain in the right inguinal region, intensified by walking and during menstruation. The bowels had remained fairly regular until two days before admission, when patient was seized with severe abdominal pain and persistent vomiting. During this time there has been no movement of bowels or the passage of any flatus. During the past few hours the vomiting has become brown, but is not of a fecal odor.

On examination the abdomen is slightly distended throughout. There is tenderness and rigidity, most marked just internal to the old appendix scar. No mass can be felt. The abdomen is tympanitic in front as well as in the flanks. General condition is that of very marked prostration, the pulse being 120 and the temperature slightly above normal.

Immediate operation. Gas and ether: A median incision four inches in length was made below the umbilicus, opening the peritoneal cavity, which contained a small amount of clear serous fluid. The small intestine was moderately distended, and was caught beneath a firm band, extending from the omentum to what appeared to be an appendix epiploica on the wall of the cæcum, but which may have been the region of the former appendix. The band was divided, the intestine released, and the cæcal attachment of the band buried with a purse-string suture of catgut. The

abdomen was irrigated with a hot saline solution and was closed without drainage. Uneventful recovery. Primary union.

Case VII. *Penetrating pistol-shot wound of the abdomen. Laparotomy; recovery. Acute obstruction from a band and from kinking of the small intestine six months later; laparotomy; recovery.*— J. K., aged twenty-two years. Patient has always been robust. In June, 1902, patient received a pistol-shot wound of the abdomen, and was taken in an ambulance to Gouverneur Hospital, where, two hours after the accident, a laparotomy was performed, and eight wounds in the wall of the small intestine and two in the mesentery were closed with suture. In order to minimize the risk of subsequent adhesion, each perforation, with the exception of two which were in close proximity to the mesenteric border, were closed with a purse-string suture of silk, and one suture over this to secure firm apposition. The bleeding vessels in the mesentery were ligated with catgut. A very moderate amount of gauze drainage was introduced at the point of the suture, and the abdomen elsewhere closed. The patient made an uneventful recovery; the patient passed flatus twenty-four hours after the operation, and on the second day the bowels moved to enema. At no time was there any nausea or vomiting. Primary union was secured, except at the central part of the wound, through which the drain protruded, and this was closed entirely by the end of the fourth week.

Since then the patient enjoyed excellent health until five days before his admission into the Presbyterian Hospital. At that time, about six months after the primary operation, patient was seized with severe colicky abdominal pain and persistent vomiting. There was complete constipation, and the patient was admitted to the hospital in a condition of collapse, with a pulse of 120 and a temperature of 102° F.

On examination the abdomen was greatly distended and everywhere rigid. The greatest pain and tenderness was just above and to the right of the umbilicus. The tympanitic note was general.

Operation, December 24, 1902. Gas and ether: The peritoneal cavity was opened by a median incision just above and

below the umbilicus. There was a considerable amount of clear serous fluid within it, and the intestine immediately presented in a greatly distended condition. In the lower part of the cavity other loops of intestine in an extremely collapsed condition were observed. A strong band, extending from the omentum to the posterior parietal peritoneum, with the small intestine beneath and tightly constricted by it, was found in the posterior part of the abdominal cavity on the right side at about the level of the umbilicus. This was divided and the intestine released. In addition, loops of small intestine were found adherent to each other and to the mesentery, and when these were divided and the intestine straightened out, the adhesions were seen to have formed at the points where the previous intestinal and mesenteric perforations had been closed, the silk sutures being still plainly visible in the wall of the intestine. The separation of these adhesions left denuded areas so extensive that they could not be covered satisfactorily with any serous investment. They were accordingly covered with cargile membrane and the intestines returned into the abdominal cavity after they had been thoroughly washed and the abdominal cavity carefully irrigated with a hot saline solution. The abdomen was closed without drainage.

After the operation the patient was restless and at times delirious. He was given early and repeated rectal injections containing turpentine, and the sides and extremities of the bed were alternately elevated and lowered. The bowels moved abundantly from the second day. The delirium ceased on the fifth day, and from then on the convalescence was uninterrupted. Primary union was secured.

At the end of about three weeks patient left the hospital. About five weeks after the operation patient had some abdominal pain and vomiting, continuing for about twenty-four hours, which he ascribed to some indiscretion in diet. Since that time the patient has been completely well.

DISCUSSION.

Dr. James E. Moore, of Minneapolis, Minn.

I was very much interested in this paper, and especially in one of the cases reported, upon which I operated. There is one rule which we should remember when we have cases of this kind to deal with, and that is to advise the patient and his friends that he is in more danger from obstruction than the average man. If the patient knows his own danger he may be saved. In this case I was not called in for four days, and then it was too late. He had been in the hands of a homœopath, and they as a class are slow to call a surgeon. Physicians should make it a rule to recognize the symptoms of obstruction promptly and call a surgeon at once.

Dr. J. F. Binnie, of Kansas City, Mo.

As to the prophylactic treatment, Dr. Eliot recommends the removal of the gauze early, but I think this is a dangerous practice. The object of the gauze is not merely to drain, but to protect against local spread of infection. If one uses gauze thus, nature will protect the rest of the peritoneal cavity by her own method. If we remove the gauze early we break down nature's barrier of exudates, adhesions, etc., and expose our patient to unnecessary risk.

Dr. A. J. Ochsner, of Chicago.

The first history that was read pointed to a practice which is exceedingly harmful—that of giving cathartics when there is an intestinal obstruction. It does not matter whether the obstruction be due to an inflammatory condition or whether it be mechanical in character. The only condition in which a cathartic would not be harmful is an impaction of feces, and in this class of cases no harm will come to the patient if no cathartic is given, provided he receives no nourishment by mouth until there has been an evacuation of the bowels, which always occurs spontaneously if the patient is placed on exclusive rectal alimentation. The giving of cathartics will simply increase the pressure above the obstruction.

It is exceedingly important for the general practitioner to be impressed with the fact that nothing but harm can come from the use of cathartics and food by mouth in every case suffering from intestinal obstruction from any cause whatever, because the use of cathartics simply increases the pressure of gas within the intestine above the point of obstruction, and it cannot possibly relieve the condition. By the time the patient reaches the hands of the surgeon he has too often progressed to a hopeless condition, chiefly because of the use of cathartics. In these cases the

rule should be to prohibit the use of every kind of food and cathartics by mouth absolutely at once when intestinal obstruction is suspected, to place the patient on exclusive rectal alimentation, and to operate as soon as the diagnosis has been made in all cases in which the intestine is in danger of necrosis due to strangulation.

If this rule were followed the mortality from intestinal obstruction would be very greatly reduced.

This plan of treatment should, however, not be used as a substitute for surgical treatment, but simply as a means of making the latter more effective.

Dr. Eliot. As to drainage, it has been my custom to remove it in the ordinary case of abdominal abscess at the end of three or four days, sometimes with the cautious assistance of peroxide of hydrogen. This has been done in a large number of cases without provoking any extension of the inflammatory process.

Although these cases of tardy obstruction are much more frequent where the amount of drainage has been abundant, the fact should be emphasized that obstruction from a similar band formation may develop in those cases where there has been no pus whatever. In one case here reported of uncomplicated interval appendix operation such a band developed, with subsequent obstruction, six months after the primary operation. Since then I have endeavored to minimize the danger by inclosing the appendix stump in a purse-string suture. A similar suture was also used in the closure of the penetrating pistol-shot wounds of the intestine in Case VII., a superficial retention suture of silk being added. It is interesting to note that, notwithstanding this procedure, it was clearly demonstrated at the time of the operation for the obstruction—six months later—that not only had a band formed overlying a suture line in the wall of the gut, but that the intestines and mesentery also were kinked and adherent to each other at the places where the sutures had been inserted.

I also wish to emphasize the importance of warning the patient or the patient's family, in any case of laparotomy, of the possibility of the development of tardy obstruction. This precaution would save many lives by preventing, at the time of the development of the obstruction, the useless and dangerous administration of cathartics, involving a delay of several days before the serious character of the difficulty is fully recognized. In several cases here reported the patients did not seek surgical relief sufficiently early, and the operation failed simply because of their general condition. Had such a delay not been incurred there is no reason why operative interference would not have proved more efficacious.

A CONTRIBUTION TO THE SURGERY OF CEREBRAL TUMORS.

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The reaction which followed the indiscriminate resort to operation for cerebral tumors, which was stimulated by the publication of the successful cases by Godlee and Horsley, has led to an ultra-conservative attitude toward the operation by most surgeons. Operation in cases imperfectly localized naturally produced discouraging results.

At the outset we must admit that only a small proportion of all cases of cerebral tumor are suitable for radical operative treatment —a proportion which varies from 2 to 8 per cent., according to various neurologists, judged on the basis of the autopsy findings, or runs up to 16 per cent., judged by the histories of those clinically diagnosed. According to Starr, about 7 per cent. of all cases are operable. This small percentage depends largely on our imperfect means of exact diagnosis and localization and on the inaccessibility of certain parts of the brain to successful surgical operation. With the improvements in the methods of cerebral localization and in technique the operation has become safer, its indications have been extended, and the proportion of operable cases is likely to increase to a certain extent. The fact should not be lost sight of that all cases of brain tumor, of whatever variety, are necessarily fatal.

The conservative attitude referred to is illustrated by v. Bergmann, one of the highest authorities on brain surgery, who would limit the surgery of brain tumors to those of the central or motor area, on the ground that an exact diagnosis is possible only in

tumors of or near this region. V. Bergmann himself, however, operates on tumors in other regions, as his published cases show, and the unfortunate outcome of many of these cases may be a factor in his ultra-conservatism. My own experience in operations on cerebral tumors and cysts—three for tumors and two for cysts—and my interest in cerebral localization induced me to collect the cases of cerebral tumors operated on (including cysts giving the symptoms of tumor), which have been reported during the past five years (101 cases), with a view to determine whether the results of the more recent operations on cerebral tumors do not justify a less conservative attitude toward their operative treatment. In this list I have included only those cases reported in the English, French, and German literature, with sufficient fulness to furnish the data required. Of my own cases two have been shown to the New York Surgical Society, and published in the *Annals of Surgery*, February, 1903, p. 276, to which reference may be made for details. Similar collections of cases have been made by Knapp, Starr, v. Bergmann, and others up to 1898. The cases reported in the five years since then would indicate whether the improvements in localization and technique justify us in extending the indications as given by v. Bergmann and in taking a more hopeful view of the surgery of cerebral tumors.

As for cerebral tumors in that part of the cerebral cortex accessible to surgical operation, the indications for operation depend entirely upon the possibility of accurate localization. What light does this series of 101 cases show as to this point? I think it shows that, in many cases at least, tumors of the prefrontal, parietal, and occipital areas can be as successfully localized and operated upon as those in the motor area. In this series of 101 cases twelve were localized in the frontal region, four of which really belonged to the motor area including the posterior parts of the second and third frontal gyri. The remaining eight cases (Nos. 11, 43, 71, 72, 73, 75, 77, and 82) were situated in the prefrontal region, and present quite a characteristic group of symptoms for aid in local diagnosis. This area, especially that on the left side, is supposed by many to have to do with the higher psychic powers and the moral sense.

From an analysis of 775 cases of brain tumor accompanied by psychic disturbances, Schuster[1] claims that certain psychic symptoms correspond to certain forms and groups of anatomical and local conditions, and that frontal tumors present moral insanity and dementia—and less often hallucinations, paranoia, and mania —more often than tumors elsewhere. Gianelli[2] says that the more prominent the psychic disorders—torpors, weak memory, etc.—the more likely is the growth to be in the prefrontal lobe, and that seventy-seven out of ninety-seven cases of tumor of the frontal lobe were accompanied by mental disturbance. All of the above eight cases of frontal tumor, irrespective of the side, show psychic symptoms, and two of them moral perversion. L. Bruns[3] says that disturbance of equilibrium characterizes tumors of both the frontal lobe and the cerebellum, but a distinct ataxic gait was present in only one of the above eight cases. To assist in the localization, three presented local tenderness on pressure or percussion, one a visible external swelling, two exophthalmos, and in two the eye was lowered and turned out.

This series of 101 cases includes five cases of tumor localized in the parietal region and found and removed by operation, besides one imperfectly localized from an insufficiency of focal symptoms. Four of these five cases were localized and reported by Mills, of Philadelphia. All of the five cases presented symptoms of sensory disturbance, and were localized by these symptoms. In four of them these symptoms included astereognosis, which was also present in the case of some tumors in the motor area where the region behind it was invaded. With reference to astereognosis, Walton[4] concludes that "it seems a safe working plan in operable cases with no other localizing symptoms than astereognosis to select for the centre of the area to be exposed a point in the ascending parietal convolution at a height corresponding to the motor representation of the extremity involved." In four of the five parietal tumors there were also motor symptoms, usually of moderate development and late appearance, and due to the forward extension of the tumor or its pressure in the course of its growth. Three of the cases also presented ataxia.

Three of the 101 cases were diagnosed and found in the occipital lobe. In all three there was homonymous hemianopsia, which, says Bruns,[3] alone or associated with appearances of optic irritation or hallucination or soul-blindness, is characteristic of tumor of the occipital lobe. Schuster[1] says that hallucinations and delirium are particularly frequent in occipital lobe tumors. In one case there was also an external tumor to assist in the localization. Among the 273 cases of operated brain tumor collected in v. Bergmann's work[5] only three of the occipital lobe are given. As the three cases out of the series of 101 include one of the writer's cases which has not been elsewhere reported, a *résumé* of it is given:

H. S., female, aged twenty-nine years. Family and previous history negative. No specific disease. One and a half years ago intense right occipital headache, nausea, and vomiting. Later on staggering, but to no particular side. Eyes: left, optic neuritis; right, atrophic disk, total blindness. Left hemianopsia. Patient dull and stupid. Semicoma alternating with delirium. Has had drawing up and twitching of left leg. Pulse rapid, weak, and hardly perceptible. Diagnosis by Dr. E. D. Fisher: tumor of right occipital lobe.

Operation, June 9, 1897. Right occipital lobe exposed by trephine and rongeur, and explored to falx and tentorium. Brain surface appeared abnormal, darker and yellower than normal, and a section was removed for examination. No limited tumor. Two and a half drachms of clear, straw-colored fluid removed by syringe from right lateral ventricle. Dura and flap sutured. Primary union. June 25th, great improvement ; no headaches, stupor, or delirium; patient quiet and rational. Discharged improved June 29th. Microscopic examination of specimen shows it to be a diffuse glioma. She died in September, 1897. The operation was merely palliative.

Enough has been said to show that tumors in the prefrontal, parietal, and occipital regions are localizable and operable, and many of the characteristic symptoms of tumors of these three regions which made this localization possible have been given.

Moreover, the results of operation on tumors in these regions have been quite as good as on those of the motor area. The number also of operations on tumors in regions other than the motor area has largely increased in the last five years, and we may justly claim that the indications for operation on cerebral tumors should be extended beyond those of the motor region.

Although in cases of brain tumor the diagnosis should be made or confirmed by a skilful neurologist, the surgeon should not be dependent on this diagnosis alone and operate in a mechanical way like a mere mechanic. To obtain the best results, and to intelligently meet the demands of the situation in an operation for brain tumor, the surgeon should have a good knowledge of the methods of diagnosis and localization as well as of cranio-cerebral topography. We may go a step farther and assert with Durante,[6] in presenting a number of cases of tumor of the pre-frontal region operated upon as a contribution to the function and localization of this part of the brain, that the surgeon in operating on cerebral lesions may contribute much to the physiology of the brain as well as to the diagnosis of such lesions. He likens the surgeon to a physiologist performing an experiment *in vivo*.

In arriving at the *diagnosis* we must consider (1) the general or pressure symptoms, and (2) the focal or localizing symptoms. Of the pressure symptoms, headache, choked disk, vomiting, and vertigo are the most important. Persistent headache is the most constant. In the above 101 cases its absence was mentioned in only eleven cases, or 10.8 per cent. It is of but little value in localizing the tumor, for it was confined to the same side in only ten cases, or 9.9 per cent. It is noteworthy that in tumors of the frontal lobe the headache, if localized, may be frontal or occipital, or both, as the pressure seems to be exerted in both a forward and a backward direction.

According to Wilder,[7] choked disk is present in 80 per cent. of cerebral tumors (90 per cent. of cerebellar tumors), and it is said that 90 per cent. of the cases of choked disk are due to brain tumor. In the present series, among the ninety-four cases where it was mentioned, it was present in only 69.2 per cent.; but among the

twenty-nine cases where its absence was noted nothing was found in three cases, cysts in five cases, sclerotic or necrotic tissue in two cases, tubercle in two cases, a gumma and a very small tumor each in one case. Deducting these fourteen cases, choked disk was present in 84.1 per cent. of the remaining cases. Wilder also says that it is of little value as a localizing sign, and that it does not furnish any information as to the nature or size of the tumor; but Gunn[8] states that optic neuritis on one side or markedly prominent on one side points to a tumor of the cerebrum, and on that same side. In sixteen cases (17 per cent.) of the ninety-four it appeared first most markedly only on the same side as the tumor, and in six cases on the opposite side.

In general, also, it is probably true that it is more regularly present, and more often pronounced and double in a large or rapidly growing tumor, and more often absent in a cystic tumor. With tumors of the motor cortex double choked disk appears late, and is frequently absent—*i. e.*, in 33 per cent. of cases according to Wilder and in 38 per cent. of my series of 101 cases. Hence, in general, choked disk in tumors of the motor area indicates a large or rapidly growing tumor.

In an analysis of seventy-four cases of cerebral tumor Singer found the absence of optic neuritis rare in cases under forty years of age, and increasingly common after that. Among the fifty cases under forty years in which choked disk is mentioned it was absent in thirteen (or 26 per cent.), against 44 per cent. in cases over forty years. Among the thirteen cases just mentioned are nine which we deducted in taking the percentage of choked disk, making choked disk absent in only 8 per cent. of cases under forty years of age.

In the present series of cases vomiting and vertigo were present in a relatively small proportion of cases, 33.3 per cent. and 22.2 per cent., respectively. Still other pressure symptoms may occur, such as slow pulse, deep respirations, psychic unrest, or general convulsions; but the decisive pressure symptom is the choked disk.

Without going into a discussion of the mechanism of the pressure symptoms and the various theories which seek to explain them,

we may say that some of the cases operated upon show the importance of the cerebrospinal fluid as a factor in the pressure symptoms, and thus support v. Bergmann's theory that the increased tension of this fluid compresses the capillaries and causes anæmia and thus irritation and paralysis of the nerve centres.

While the pressure symptoms, combined with the course of the disease and exclusion, may enable us to diagnose a brain tumor from other brain lesions, they do not enable us to localize it so that we are justified in attempting its removal. An exact localization, says Oppenheim, is necessary for surgical treatment; and "only the relative certainty of the diagnosis gives us the right to do a dangerous operation" is the statement of v. Bergmann. The focal or localizing symptoms, due to the destruction of or the local pressure on some particular part of the brain whose function is known, vary with the position of the new-growth and hence lead to its localization.

There are two other means of localization of brain tumors that may prove of much assistance—percussion or pressure and the X-ray. In the series of 101 cases collected local tenderness on percussion or pressure over the tumor was noted in twenty-one cases. Two of these were subcortical, including one tubercle, the remaining nineteen cortical or surface growths, including two cysts, three gummata, one case of necrotic tissue, and three cases of painful tumors, appearing on the surface. If percussion or pressure are very tender locally the tumor is probably superficial.[5] Macewen has called attention to changes in resonance on percussion over cerebral tumors—*i. e.*, tympanites, increased dulness, and cracked-pot sound—which are of service in localization when circumscribed, and in general diagnosis when more diffuse. In two cases on the list increased dulness was noted, and in one case (No. 51) it was the only marked localizing sign. In two cases there was tympanitic resonance, and in one of these cases (No. 75) also this symptom and local tenderness were the principal localizing signs. In cases of difficult diagnosis the local tenderness and percussion note may be even more important than the cerebral symptoms.[3] Carson[9] reports a case to show that the cranial cracked-pot sound

may be a valuable sign of cerebral tumor, and claims that it is due to a separation by pressure from within of the sutures which had previously come together. In one case (No. 63), in a child of eight years, there was a cracked-pot sound on both sides. It is to be remembered that changes of the cranial percussion note are present in other conditions than tumors, especially traumatic lesions associated with blood clot. (See also Paoli and Mori, *Il Policlinico*, February 15, 1898.) In six cases of the series there was an external swelling, three of which were tender to pressure.

The X-ray has only lately been tried in cases of suspected brain tumor. In one case of the series (No. 61), a glioma of the motor area, it was negative; while in four others (Nos. 68, 69, 76, and 96), including three sarcomata and a gumma, it was positive. These and a case of glioma of the cerebellum reported by Church, of Chicago, include all the reported cases that I know of where the X-ray was positive. In two of these cases the bones of the vault were noted as being very thin. Obici and Bollici[10] demonstrated post-mortem by means of the X-ray a sarcoma of the brain in a boy, proved it by dissection, and experimented on the cadaver. The great importance of attention to special details in this work is emphasized.

For the purposes of operative treatment it would be very desirable to have a still more exact diagnosis, to know whether the growth is cortical or subcortical, and what its size and nature are. It was pointed out some time ago by Seguin and Mills that paresis with predominance of tonic spasm, such as frequent attacks of Jacksonian epilepsy, indicate a cortical lesion, though this symptom is present in a few subcortical tumors. If percussion is very sensitive locally the tumor is probably superficial. In large tumors the symptoms due to pressure are usually very marked, and the focal symptoms indicate a wide extent of involvement or pressure. Tumors of the motor cortex where double optic neuritis is marked are probably of large size.

We are still less able to diagnose the nature of the tumor. Pressure symptoms, including choked disk, are probably less common or less marked with a cyst than with a solid tumor of equal size,

though it is difficult to diagnose a cyst from a small, solid tumor. Rapidly growing tumors, as indicated by the course of the symptoms, should indicate malignant growths, glioma, sarcoma, etc.; but many of the latter grow slowly, as indicated by the duration of the symptoms in such cases. This is especially true of the fibrosarcomata and spindle-celled sarcomata, fourteen cases of which averaged nearly three years, while the small, round-celled variety shows a much shorter duration. We know, too, that the so-called malignant tumors are by far the most common. Thus, in this series of cases, among the eighty-eight cases in which the variety of the tumor was mentioned, forty-four (50 per cent.) were sarcomata (including gliosarcoma), eleven (12.5 per cent.) were gliomata, ten cysts, five fibromata, five gummata, three tubercles, two angiomata, two endotheliomata, two cortical scleroses, and four single examples of other forms. There were also six cases in which nothing was found, and seven in which the variety was not mentioned.

At times we may diagnose with some certainty a gumma or a tubercle from the previous history or the present condition. We can rarely, if ever, tell whether a tumor is encapsulated or not, though Singer[3] says that out of seventy-four cases of autopsied cerebral tumors all of the nine which had had no optic neuritis were over forty years of age and had infiltrating malignant growths.

The importance of the accurate localization of cerebral tumors is shown in Van Hippel's statistics, given by v. Bergmann,[5] in which out of 116 cases accurately localized the tumor was removed, in all, 60 per cent. were improved or cured and 7 per cent. were not improved or died of the operation. On the contrary, in 157 cases when the localization was defective and the operation was more or less exploratory, 47.7 per cent. died as the result of operation. Out of 111 cases collected by Knapp[12] where the tumor was not found fifty-eight (52 per cent.) died, and in about 21 per cent. of all operated cases there was a failure to remove the tumor owing to errors in diagnosis.

The *indications* for operative treatment are clear. A radical operation is indicated in cases where the tumor can be satisfactorily

located in a region accessible to surgical operation when there is no evidence of malignant disease elsewhere, of a very large cerebral growth or of multiple growths. V. Bergmann is opposed to operation on supposed gummata, Horsley in favor of it, and the weight of evidence is in favor of the latter view. The mortality and results are more favorable with gummata than with any other form of new-growth. Moreover, other forms of tumor may occur in those giving a syphilitic history, as occurred in at least one of the appended series of cases, and a gumma may occur when no history of syphilis is obtainable; so that we cannot be sure of the nature of the growth until we have exposed or, perhaps, even examined it. Although antisyphilitic treatment may temporarily improve the symptoms due to a gumma and even those due to other forms of tumor, it probably rarely, if ever, causes the entire absorption of the gumma, so that an operation is the only sure radical cure.

Solitary tubercles have also given good results, Horsley's and other cases having remained well five to seven years.

Opinion is divided as to palliative operations, but personally I think they are strongly indicated where the tumor is not to be localized or is inaccessible, in order to relieve the symptoms most complained of—headache, loss of vision, etc.—when these are pronounced. Such operations are comparatively safe. Knapp[12] gives 14 per cent. of mortality in sixty-eight cases, and I think this figure is too high for the present results. The temptation to make such an operation a thorough exploratory one should be resisted, for the weight of opinion is against exploratory operations.

The *prognosis* is hard to give in advance, as so much depends upon the conditions found. It should never be lost sight of that all cerebral tumors, even the most benign, are necessarily fatal if nothing is done for them. The mortality, according to the statistics of Chipault and of Starr, is about 56 per cent.; the tables of Knapp make it 43 per cent. before 1891, 33.4 per cent. from 1891 to 1898. In 1899 v. Bergmann found that 25 per cent. of cases died as the direct result of the operation. The improvements in localization and operative technique have reduced the mortality of cases oper-

ated on in the last five years. In the series of cases I have collected twelve cases (11.8 per cent.) died within twenty-four hours, and twenty-six (25.7 per cent.) within three weeks. If we select the eighty-eight cases where an exact localization was made, the mortality was somewhat less—22.7 per cent. as against 46 per cent. among those not exactly localized. In the table are twelve cases of Gussenbauer's, with only one death, and that due to pneumonia. As to the more remote prognosis, six died between three weeks and three months, nine between three months and one year, and three between one and two years. As almost all of these died from the effect of the tumor, the mortality within two years is 43.5 per cent. This probably does not represent the actual mortality within this period, for a large number are reported within a comparatively short time after the operation—in one case only two weeks.

In spite of the high mortality we must admit that the immediate and remote mortality is no greater than follows radical operation for malignant growths in some other situations. When we consider the otherwise hopeless condition of these cases, the difficulties of exact diagnosis, the inaccessibility of the tumors and the marked relief of symptoms in almost all cases not dying at once, we may take courage and feel some degree of satisfaction. When we look at the other side of the question—the length of time during which some cases remain free of recurrence—we may feel still more encouraged. Cases of sarcoma are reported four years, four years and one month, five and one-half years, and eleven years after operation. The last case—one of Durante's—then recurred, was again operated, and was well six and one-half years later. A case of fibroma was reported well eight years, cases of gummata two and two and one-half years, a case of glioma three and one-half years, and one case, in which the variety of tumor was not given, nine years after the operation. Seven cases of sarcomata are reported to have recurred at periods ranging from three months to eleven years, and averaging two years and four months or, exclusive of the latter case, nine and one-third months.

Gussenbauer[13] says that in gliosarcomata the prognosis can be

made only with great reserve even when removal is apparently within normal tissues. In one of his cases recurrence was first evident after three years. McCosh removed a brain tumor, pronounced fibroma by the pathologist, which recurred as a sarcoma in a few months. Naturally the remote prognosis of malignant tumors anywhere is not good at best, especially when not encapsulated, so that the above results are far from discouraging. At least we do not have to fear glandular metastasis in the malignant tumors we meet with in the brain. In reference to recurrence, v. Bergmann says that among the tumors which grow in the cortex, and can therefore be reached by the knife, those are most frequent which promise favorable results from an operation, viz., tough fibromata and sarcomata which are well encapsulated, have their seat of predilection in the gray matter of the cortex and, when once removed, do not seem to recur.

The prognosis of cysts should not be given without reserve. My first case, operated in 1893, is an example of this: K. R., female, aged eighteen years; fracture of right temporofrontal region at two and one-half years, followed by three operations. At seven years Jacksonian epilepsy on left side, with aura in left hand extending to left foot; tremor of left extremities. Operation: right motor area exposed, and appeared normal; old scar and gap in bone exposed; cyst opened leading back to beneath motor area; drainage; four hours later collapse; temperature 104° F.; stimulation and reaction; unconsciousness; temperature rose to 108° F.; death in thirty-six hours; no autopsy; no apparent infection. Without particular care there is always the danger of infection in a cyst as long as drainage is employed. As to the remote prognosis of cysts, v. Bergmann says that traumatic cysts are not common and of small size, and that brain cysts more often occur in sarcomata of the brain from the softening and breaking down of nearly the entire tumor. When the fluid of a brain cyst is rich in albumin, and the cerebrospinal fluid from a lumbar puncture is poor in albumin, the cyst is always one derived from a sarcoma. In a case of Vallor's the sarcomatous nature of the cyst was first known after three years.

In the evolution of the *technique* the *operation* of craniectomy for the exposure and removal of cerebral tumors has undergone much change and great improvement, with a resulting improvement in the mortality. It is significant that infection was the cause of death in but two cases on the list. Trephining and enlarging the opening by the rongeur was too slow, and if a sufficient exposure was obtainable an unpleasantly large opening was left in the skull. The Wagner osteoplastic flap was a great advance, and revolutionized cerebral surgery, for a large area is rapidly exposed for examination, plenty of space is afforded for operation, and by replacing the flap the objection of leaving a large, uncovered area of brain is obviated. But here, too, the chisel and mallet was somewhat slow and theoretically liable to cause concussion, though I have not found it so in practice. Mills[14] says it is of the utmost importance that some speedier method of opening the skull, and some method accompanied by less cranial concussion, should be employed. In my last two cases I have employed with satisfaction Doyen's electric circular saw. A small opening is rapidly made with a burr at each angle of the quadrilateral flap, the thickness of the skull is measured at these openings, and a collar of such a size adjusted on the saw that the latter will not quite cut through the inner table. The latter is broken by the blow of a chisel with a probe-pointed lower angle, and the flap is raised up, breaking the base as a hinge for the flap. This fracture may be facilitated by sawing partly through from beneath with a Gigli saw, and the latter may be used for the entire sawing required, but it takes considerably longer. If one uses the Gigli saw slowly no protection of the dura is necessary. I have had no experience with the Stellwagen trephine, but it does not seem to have fulfilled its promise.

Hemorrhage is an important factor in these operations, and I am convinced that it is the chief cause of shock in the surgery of cerebral tumors. In two or more cases in the series death was directly attributed to it, and in at least four cases the operation was done in two stages on account of hemorrhage.

It is naturally free from the scalp, and sometimes unusually so. I have often controlled it by elastic tubing drawn tightly around

the head above the eyebrows and ears or, when this fails, by temporary overlapping, interrupted silk sutures below the base of the flap, and above it if necessary. Continued oozing from the cut surface of the bone may be controlled by pressure with or without the use of Horsley's powdered wax, pressed into the diploë. If we minimize the hemorrhage in the first part of the operation I think it will seldom be necessary to follow Horsley's advice to operate in two stages, going as far in the first operation as raising the bone flap. After losing a case from hemorrhage, v. Bergmann advises this plan when the first stage of the operation causes symptoms of collapse. This was practised in at least four cases in the series of 101 cases, and in one case (No. 69) at the second operation Crile's plan of temporarily clamping the carotids was employed.

The flap of dura, cut about one-quarter of an inch from the bony margin, may be turned back in the same or, according to Keen, in the opposite direction to the bone flap. The stage of approach to the cortex is now finished, and if the tumor is in or on the cortex its removal is usually a simple matter. After incising the pia about them, most tumors—unless disseminated or not encapsulated—are best shelled out with the finger. If nothing is seen on the cortex, the tumor, if present, must be subcortical, and to find it we first palpate the surface exposed. If we cannot feel it, v. Bergmann advises raising the patient to a sitting posture, whereupon the tumor may become visible or palpable, the area exposed sinking in somewhat from the atmospheric pressure in connection with the lessened blood pressure. This plan was successfully used in one case (No. 70) by Ransohoff. If this fails, electrical stimulation may be and has been used to exactly locate the explosion centre of the Jacksonian attacks. Singularly enough, this not infrequently gives no muscular contractions, a fact explained by some by supposing that the deep anæsthesia inhibited them; but the same result has been obtained when the patient was allowed to partly come out of the anæsthesia.

If these means fail, then, in locating the centre of the area involved, as indicated by the diagnosis as accurately as possible from the landmarks of the exposed area, we may make a small antero-

posterior incision through the cortex and explore with a probe, grooved director, aspirating needle, or the little finger. The first three may be carefully introduced in various directions. Unless we have a positive result with the X-ray, we would not be justified in going any farther. The above exploration is proper and indicated in cases confidently localized; contraindicated in those that are not. An example of a spontaneous disclosure of a tumor and cyst was presented by my last case operated upon (No. 98), where in laying back the dural flap the brain protruded very prominently, its cortex ruptured and opened a subcortical cyst, which forcibly evacuated itself on account of the increased pressure. On enlarging the opening I enucleated a tumor, a fibroma, by means of the finger, from the mesial wall of the cyst. (See *Annals of Surgery*, February, 1903, p. 276.)

Bleeding from the cavity left by the tumor should be controlled, as far as possible, by ligature or gentle packing. I believe in always leaving a drain, at least of folded rubber tissue, through the sutured dura to give outlet to the oozing; otherwise the bleeding, which may start afresh, may work its way into the surrounding brain tissue, like a cerebral hemorrhage, or between the dura and brain, and thus add to the area of brain substance destroyed or cause cerebral compression. The drain may be removed in forty-eight hours.

I have never had any trouble from hernia cerebri, though it is still a not uncommon complication, due, in many cases at least, to lack of drainage or to infection. Suture of the pericranium and scalp, allowing for free drainage, completes the operation.

In palliative operations, and where the tumor cannot be found, the bone should be removed from the flap to relieve the increased intracranial pressure and the symptoms due to it, introducing rubber tissue or, better still, a thin plate of celluloid to prevent union of the scalp and dura. In a considerable number of flap operations for various purposes I have had no failure of union of the bone flap.

The results vary from a nearly complete cure to the relief of the distressing pressure symptoms, and in a few cases no improvement whatever has been noted (six out of 101).

Absolute cure or *restitutio in integrum* is rarely, if ever, to be expected on account of the necessary damage to the brain substance by the tumor and the operation of enucleating it; still, in sixteen out of 101 cases (including my last case) the symptomatic result was so good as to be considered a cure, and in forty-one cases the result has been improvement, often so marked as to be nearly a cure.

In spite, then, of the small percentage of operable cases, the difficulties of diagnosis, the uncertainty of prognosis, the fairly high mortality, the liability to recurrence, and the difficulties of the operation, and in view of the results obtained and the fact that even benign cerebral tumors are necessarily fatal, I think that the radical operation is justifiable and indicated in selected cases, and the palliative operation in another group of cases of cerebral tumors.

I would like to emphasize the following conclusions:

1. The sphere of operation for cerebral tumors may be and has been extended to those parts of the cortex where tumors are accessible and localizable—*i. e.*, to the prefrontal, parietal, and occipital regions, in addition to the motor area.

2. The prognosis, both immediate and remote, is as good as or even better than in operations for malignant growths in some other locations.

3. This prognosis has improved with the improvements in localization and operative technique, and with the limitation of the radical operation to cases accurately localized.

4. The palliative operation is strongly indicated to relieve symptoms where localization cannot be accurately made or the tumor cannot be removed. The exploratory operation is contraindicated.

5. Practically all circumscribed growths of moderate size are suitable for operation.

6. The osteoplastic method should be employed and the most rapid and perfect technique adopted which the circumstances allow.

No.	By whom and where reported.	Sex and age.	Choked disk.	Headache.	Position.	Variety.	Operator.	Recovery.	Cure.	Improvement.	Deaths.	Remarks.
1	Oliver and Williamson. Brit Med. Journ., Nov. 26, 1898.	M. 34	+	+	R. motor area.	Small round-celled sarcoma.	Williamson.	+	+	...	...	1½ years later, apparent slight recurrence.
2	Ibid.	F. 23	+	+	L. motor area (lower part).	Angioma.	"	+	...	+ great.	...	Only paresis of hand remained.
3	K. Bonhoeffer. Monats. f. Psych. u. Neurol., 1898, iii. 297.	M. 28	+ late.	+	R. motor area (anter. part).	Glioma.	Mikulicz.	+	...	+	...	Recurrence; death in three months.
4	Ziehen Zeits. f. prakt. Aerzte, 1898, 113.	M. 45	—	—	L. motor area.	Fibrosarcoma.	Riedel.	+	...	...	... 2d wk	Death from meningitis.
5	Haasler. Archiv. f. Psychiatrie, 1898, xxx. 660.	M. 29	+	+ r. side.	R. motor and front. region.	Spindle-celled sarcoma.	v. Bramann.	+	...	+ great.	...	Shown 5½ years later; no recurrence.
6	Nedwill. Lancet, 1898, p. 1466.	F. 17	+ right.	+	R. motor area.	Hydatid cyst	Nedwill.	+	...	+	...	
7	Kosinski. Medycyna, 1898, pp. 1-5.	M. 26	+ right.	+	" "	Angiosarcoma	Kosinski.	+	...	+ great.	...	
8	v. Friedlander und Schlesinger. Wien. klin. Woch., 1898, No. 4.	M. 43	+	+	L. motor area inf. and ant.	Gumma of dura.	Albert.	+	...	+ great.	...	Nearly a cure.
9	Schlesinger. Ibid.	M. 23	?	?	R. motor area.	Fibroma.	"	+	...	+ great.	...	No recurrence 8 years after.
10	Ibid.	M. ?	+ late.	+	" "	Gliosarcoma.	Ewald.	+	...	+	...	Symptoms returned in five months; death 6-7 mos.; r. hemisphere infiltrated.
11	Thomas and Keen. Year Book of Med and Surg., 1898, pp 410 and 719.	M. 17	+ left.	—	2d l. frontal convolution.	Sarcoma.	Keen.	+	...	great.	...	Tumor subcortical; lateral ventricle opened and drained.
12	W. C. Krause. New York Med. Jour., July 30, 1898.	M 45	late.	r. side.	R. motor area.	Small round-celled sarcoma	R. G. Wilcox.	...	...	...	14 days.	Temporary improvement; multiple tumors found.
13	Ibid.	F. 42	+ right.	+	L. motor area.	Glioma.	"	+	...	...	19 days.	Death from pneumonia.
14	Ibid.	M. 40	+ double.	+	R. motor area.	?	.....	+	...	+	...	Left hospital in 8 months.
15	Crowley. Trans. Med. Soc., California, 1898, p. 202.	F. 42	?	—	L. motor area.	Fibrosarcoma.	Stratton.	+	...	+	...	Recurrence; second operation in 9 months; death a few days later.
16	Grisson. Neurolog. Centralbl., 1898, p. 1138.	M. 27	—	+	L. motor area (post. part).	Cyst	Grisson.	+	+	...	...	
17	S. E. Henschen. Mittheil. a. d. Grenzgebiet d. Med. u. Chir., 1898, No. 3.	M. 45	—	?	L. motor area.	Cystoglioma.	Lennander.	+	...	+	...	Cyst partly extirpated; repeated recurrences and operations. Death in 8 months.
18	Ibid.	M. 45	+	+	R. motor area.	Spindle-celled sarcoma.	"	+	...	+	...	Death 3 years later; hemorrhage caused operation to be suspended.

19	Willy Meyer. Ann. of Surg., 1898, xxvii. 770.	M. 30	+	+	R. motor area.	Cyst.	Meyer.	+	...	+	...	Hernia cerebri; skin grafted; report 4 months later.
20	A. Wiener. New York Med. Journ., Oct. 15, 1898.	M. 20	+	+	L. motor area.	Glioma.	Gerster and Lilienthal.	+	...	+	...	Recurrence; condition hopeless; operation in two stages for hemorrhage.
21	J. M. Nicholl. Lancet, Oct. 29, 1898.	M. 12	+ right.	+ r. side.	R. petrous bone pressing on r. temp. sph. lobe.	Alveolar sarcoma.	Nicholl.	+	...	+	...	Recurrence; death in 2½ months; removal incomplete.
22	Gordinier. Albany Med. Annals, Sept., 1898.	M. 49		+	R. motor area.	Small round-celled sarcoma.	Seymour.	+	...	+	...	Tumor subcortical in centrum ovale; none seen or felt at operation.
23	Pearce Gould. Clin. Soc. Trans., 1898, xxxi. 286.	M. 41	—	+	?	?	Gould.	+	+	...	...	Was there a tumor? none found.
24	Liepmann. Monatschr. f. Psych. u. Neurol., 1899, iii. 407.	F. 32	—	+	?	?	Kolaczek.	+	...	—	...	No improvement; was there a tumor? none found.
25	Adenot and Carrier. Archiv. provincal de Chir., 1898, p. 154.	F. 11	—	—	L. motor area, upper third.	Glioma.	.....	+	...	—	...	Worse rather than better.
26	E. Hitzig. Mitth. a. d. Grenzgeb. d. Med. u. Chir., 1898, iii. 367.	M. 48	—	—	R. motor area, middle third.	Cyst.	.....	...	...	...	24 hours	
27	Seydel. Münch. med. Woch., 1898, Nos. 9, 10.	M. 47		+	L. motor area.	Fibroma of dura.	Seydel.		+	...	...	Recurrence; second operation; death in 2½ years; operation in two stages.
28	Putnam & Richardson. Boston Med. and Surg. Journ., Feb. 9, 1898.	M. 38	+	+	" "	Sarcoma.	Richardson.	+	...	+	...	Death 7 mos. after second operation, 10 mos. from first; tumor subcortical.
29	Gordinier. Amer. Journ. of Med. Sci., May, 1899.	F. 37	+	+	2d l. frontal convolution.	Glioma.	E. D. Ferguson	..	...	...	+	Agraphia and no aphasia.
30	J. M. Ball. Phil. Med Journ., Oct. 28, 1899.	M. 57	double.	...	R. operculum and insula.	Spindle-celled sarcoma.	Lanphear.	...	...	...	few hours	Insufficient date for localization; operation on wrong side.
31	Bayerthal. Münch. Med. Woch., 1899, No. 46.	M. 29	—	—	R. paracentral lobule.	Solitary tubercle.	Heidenhain.	+	...	+ great.	...	Report 1 year later; operation in two stages; tumor subcortical.
32	R. Haas. Beiträge z. klin. Chir., 1899, p. 601.	M. 41	—	+	R. motor area, upper ¼.	Spindle-celled sarcoma.	Czerny.	+	+	...	...	
33	Ibid.	F. 13	+	+	?	?	"	+	...	...	+	Death 10 days after second operation; nothing found.
34	Ibid.	M. 5	?	?	?	?	Jordan.	+	...	+	..	Nothing found.
35	Ibid.	M. 55	—	+	R. motor area.	Round-celled sarcoma.	Czerny.	...	...	...	+	
36	Handford. Brit. Med. Journ., March 11, 1899.	M. 19	+	+ r. side.	" "	Osteoma.	Anderson.	+	...	+	+	
37	Bramwell. Clin. Journ., 1900, p. 385.	M. 54	—	—	" "	Spindle-celled sarcoma.	Cotterill.	+	...	—	...	Nothing seen or felt; died in 3 months; no pressure symptoms; tumor subcortical.
38	Ibid.	M. 35	—	—	" "	Sarcoma.	"	+	+	...	...	

No.	By whom and where reported.	Sex and age.	Choked disk.	Headache.	Position.	Variety.	Operator.	Recovery.	Cure.	Improvement.	Deaths.	Remarks.
39	Hoche. Deut. Zeitschr f. Nervenheilk, 1900, p. 149.	F. 54	—	?	R. motor area.	Spindle-celled sarcoma.	B. Lange.	...	...	...	+ 12 days.	Some tumor tissue left.
40	A. Delobel. Gaz. hebd. de Med. et de Chir., 1900, p. 682.	M. 32	—	—	Median.	Fibrosarcoma.	Verstraeta.	...	...	...	+ 2 days.	
41	Apert & Gandy. Archiv. gén. de Méd , 1900, n.s., iii. 581.	M. 45	—	+	R. motor area.	Fibroma.	Marion.	...	...	...	+	Died next night after temporary improvement.
42	Van B. Knott. Journ. Amer. Med. Assoc., 1900, i. 978.	M. 14	—	+	R. motor area (ant.).	Cyst.	Knott.	+	...	+ great.	...	Thin walls of cyst removed
43	Durante. Brit. Med. Journ., 1900, ii. 1462.	M. 20	+	+	R. frontal area	?	.....	+	...	+ great.	...	Recurrence in 8 mos., operation; recurred again in 8 months, and death.
44	Mills, Spiller and Keen. Journ. Nerv. and Ment. Dis., May, 1900.	M. 57	—	+ 1. side.	L. parietal lobe.	Endothelioma.	Keen.	+	+	...	...	Cyst opened in removing tumor.
45	F. R. Sherwood. Chicago Clinic, 1900, xiii. 390.	F. 43	+	+	R. motor area, upper third.	Fibroma from dura.	Sherwood.	+	...	+	+ 2 wks	Temporary improvement.
46	Steffenson. Med. News, Feb. 3, 1900.	M. 32	+	+	L. parietal region.	?	L. D. Rogers.	...	...	...	+ 2 hrs.	Death due to hemorrhage and shock.
47	Hale White. Guy's Hosp. Reports, 1901, lv.	F. 18	+	+	L. nucleus caudatus.	Spindle-celled sarcoma.	White	+	...	...	...	Temporary improvement after the third and fourth operations; patient finally died.
48	Krönlein. Centralbl. f. Chir., 1901, Beilage, p. 46.	M. 61	—	+	R. motor area.	Spindle-celled sarcoma.	Krönlein.	+	...	...	...	Tumor not found; probably small at operation; died in 1½ years; autopsy.
49	Heidenhain. Ibid., p. 42.	M. 52	+ left.	+	R. motor and par. area.	Cystic sarcoma	Heidenhain.	+	+	...	...	Tumor subcortical.
50	Ibid., p. 44.	M. 19	+	+	R. temp. lobe.	Melanotic carcinoma.	"	+	...	...	...	Died in 3 months; diagnosis by Edinger. Hearing and musical sense in left ear normal after removal of entire temporal lobe.
51	Clarke and Lansdown. Brit. Med. Journ., Apr. 13, 1901.	M. 26	+ left.	+	Post. inf. angle l. par. bone.	Spindle-celled sarcoma.	.....	+	...	+	...	Second operation in a few weeks, and large tumor removed.
52	H. H. Hoppe. Journ. Amer. Med. Assoc., Feb. 2, 1901, p. 302.	M. 32	—	+	R. motor area.	?	Ransohoff.	+	...	+ great.	...	Nearly a cure; report 9 years later.
53	Ibid.	M. 18	+	+	L. occipit. reg.	Glioma.	R. Sattler.	+	+	...	...	Sight largely restored; at work in a mine 3 to 4 years later.

54	Ibid.	M. 10	+	?	R. motor area.	Tubercle.	Ransohoff.	...	...	...	— 6 hrs.	Tubercle ¼ in. below bottom of incision, found at autopsy.
55	Ibid.	M. ?	+	+	" "	Gliosarcoma.	"	...	...	...	— same day.	Death from shock; nothing found at operation.
56	Leszynski and Glass. Med. Record, Sept. 28, 1901.	M. 56	?	—	" "	Endothelioma.	Glass.	+	...	?	...	Report 2 years after operation.
57	J. Stewart. Amer. Med., Dec. 21, 1901.	M. 37	+	?	L. motor area, inf. and ant.	Glioma.	J. Bell.	+	+	...	...	Report 9 mos. after operation; cyst around tumor.
58	Dunning. St. Paul Med. Journ., 1901, p. 78.	M. 62	?	?	R. motor area.	Sarcoma.	C. A. Wheaton	?	+	..	...	Patient a physician, practising 4 years later.
59	Mingazzini. Deutsche Zeitsch. f. Nervenheilk., 1901, xix. 1 et seq.	M. 51	—	+	R. insula and corp. striatum.	Spindle-celled sarcoma.	Montenovesi.	...	...	...	+ 2 days.	Tumor found at autopsy, not felt at operation; fracture 3 months old.
60	Ibid.	F. 38	+	?	L. motor reg. ant. part.	Glioma.	Postempsky.	+	...	+	...	Some astereognosis remains in right hand.
61	Ibid.	M. 40	+	+	L. motor and parietal areas.	Fibrosarcoma.	Durante.	+	...	+	...	X-ray examination negative.
62	C. K. Mills. Phil. Med. Journ., April 20, 1901.	M. 65	+ left.	+ l. side.	L. sup. par. convolution.	Gliosarcoma.	Keen.	...	...	...	+ 2 dys	
63	Ibid.	M. 8	+ double.	+	R. sup frontal convolution.	Sarcoma.	"	+	+	...	...	Report 3 mos. after operation.
64	Walton and Paul. Journ. Nerv. and Ment. Dis., 1901, p. 191.	F. y'g	—	+	R. motor and parietal area.	Cyst.	Warren.	?	...	+	...	Died in 4 weeks; temporary improvement.
65	Ibid.	F. y'g	+ late.	+	L. motor area and parietal lobe.	?	Beach.	?	...	+	...	Improvement confined to pressure symptoms; operation palliative.
66	Ibid.	F. 27	+ double.	+	R. motor area and parietal lobe.	Old clot.	Warren.	+	...	...	...	Condition about the same 1 month later.
67	McCuskey and Porter. Journ. Amer. Medical Association.	M. 34	+ first right.	+	R. motor area.	Glioma.	Porter.	+	...	?	...	Tumor felt ½ in. below surface by needling.
68	C. K. Mills and G. E. Pfahler. Phila. Med. Journ., Feb. 9, 1902	F. 32	+ double.	+	L. par. reg. and motor area.	Fibrosarcoma.	W. J. Hearn.	...	...	...	+ 2 hours	X-ray shadow.
69	Mills, Pfahler & Deaver. Phil. Med. Journ., Sept. 27, 1902.	F. 21	+	?	R. motor area.	Spindle-celled sarcoma.	J. B. Deaver.	...	...	...	+ 3–4 hours	Two stages because of hemorrhage; carotids clamped by Crile's method; X-ray shadow.
70	Ransohoff. Journ. Amer. Med. Assoc., Oct. 11, 1902.	M. 30	—	—	L. motor area.	Solitary tubercle.	Ransohoff.	?	...	? marked.	...	Report 3½ months later; pulm. tuberc. 5 years ago; operation in two stages; nothing felt till sitting up.
71	Durante. Brit. Med. Journ., 1902, ii. 1822.	F. 35	+	?	L. frontal lobe.	Fibrosarcoma.	Durante.	?	+	...	...	Symptomatic cure; recurrence; second operation 11 years later; same as next case.

No.	By whom and where reported.	Sex and age.	Choked disk.	Head-ache.	Position.	Variety.	Operator.	Recovery.	Cure.	Improvement.	Deaths.	Remarks.
72	Durante. Brit. Med. Journ., 1902, ii. 1822.	F. 46	?	?	L. frontal lobe.	Fibrosarcoma.	Durante.	+	+	...	...	Symptomatic cure; report 6½ years later; no recurrence.
73	Ibid.	M. 39	+ left.	+	" "	Gumma (subcortical).	"	+	+	...	...	Report 6 years later.
74	F. X. Dercum. Journ. Nerv. and Ment. Dis., 1902, p. 347.	M. 23	+ double.	+	L. motor area and 2d front. convolution	Spindle-celled sarcoma.	Keen.	?	...	...	...	Result not given; hemorrhage severe.
75	W. W. Keen. Ibid.	F. 43	+	+	L. front. lobe.	Spindle-celled sarcoma.	"	...	...	...	+ 4 hrs.	Death from shock; hemorrhage free.
76	C. K. Mills. Phil. Med. Journ., Nov. 29, 1902.	M. 27	+	+	L. motor area.	Gumma.	W. J. Hearn.	+	...	+ great.	...	Report 4 weeks after operation; X-ray shadow.
77	E. v. Bergmann. Archiv f. klin. Chir., 1902, lxv. Heft 4.	M. 34	+ right.	+	R. front. reg.	Angiosarcoma	v. Bergmann.	+	...	+ great.	...	
78	Ibid.	M. 4½	+ double.	...	L. motor area.	?	"	...	...	...	+	Death due to shock.
79	Ibid.	M. 44	—	+ l. side.	" "	Cavernous angioma.	"	...	...	...	+	Death from hemorrhage.
80	Ibid.	F. 46	+ right.	+	" "	Round-celled sarcoma.	"	+	...	...	+ 15th day.	Died of purulent meningitis; tumor only felt when patient sat up.
81	C. Thiem. Centralbl. f. Chir., 1902, Beilage, p 56.	M. 38	+ right.	+	L. occip. lobe.	Cystic tumor.	Thien.	+	+	...	...	Right hemianopsia present.
82	W. Elder and A. Miles. Lancet, Feb. 8, 1902.	M. 47	+	+	L. prefront. reg.	Gumma.	Niles.	+	+ great.	...	...	Report 4 mos. after operation.
83	Gussenbauer. Wiener klin. Woch., 1902, p. 1434.	M. 11	right.	+	R. motor area.	Gliosarcoma.	Gussenbauer.	+	...	+	...	Died in 4 months or more; operation palliative; nothing seen or felt.
84	Ibid.	M. 42	—	+	L. motor area.	Large round-celled sarcoma.	"	+	...	+	...	Recurrence; death 2 years after operation.
85	Ibid.	M. 22	+	+	?	?	"	+	...	...	...	Result negative; nothing seen or felt.
86	Ibid.	M. 31	+ right.	+	L. motor area.	Sclerosis of cortex.	"	+	...	...	...	Worse rather than better.
87	Ibid.	F. 12	+ right.	+	R. motor area.	Gliosarcoma.	"	+	...	+	...	Well 2 years later; died 3 years and 1 month after operation; lateral ventricle probably opened.
88	Ibid.	M. 38	—	+	" "	Gumma.	Funke.	+	...	+	...	Last seen 2½ months after operation.
89	Ibid.	F. 24	—	+	" "	?	Föderl.	+	...	+	...	Symptoms persist 1 year after operation; nothing seen or felt at operation.

90	Ibid.	M. 53	—	+	L. motor area, post. part.	Necrotic tissue.	Gussenbauer.	+	...	+	...	Report 2 weeks after operation; local tenderness on percussion present.
91	Ibid.	F. 13	+	+ l. side.	L. motor area.	Cyst.	"	+	...	+ great.	...	Last report 1 month after operation; left parietal resonance tympanitic.
92	Ibid.	F. 38	+ right.	+	R. motor and sup. front. area.	Gliosarcoma.	"	+	...	+	...	Improvement lasted 7 mos.; death 7 mos. after operation.
93	Ibid.	M. 43	+	+	R. motor area?	?	"	+	...	+	...	Improvement temporary; death 6 months after first operation; nothing found at first or second operations.
94	Ibid.	F. 21	—	+	L. front. reg.	Round-celled sarcoma.	"	...	...	...	+ 5 hrs.	Painless frontal tumor.
95	Starr & McCosh. Presb. Hosp. Reports, 1902, p. 1.	F. 45	+	+	R. motor area.	Small round-celled sarcoma.	McCosh.	+	...	+	...	Report 1 year after operation; astereognosis remains in left hand.
96	Killiani. Ann. of Surg., April, 1903, p. 610.	M. 32	+	+	L. motor area.	Gliosarcoma.	Killiani.	+	...	+	...	Died 4½ mos. after operat'n from infection of persisting sinus; X-ray shadow.
97	Woolsey. Ibid., Feb., 1903, p. 274.	F. 46	—	+	L. motor and par. area.	Sclerosis of cortex.	Woolsey.	+	...	+	...	Improvement continues 1½ years after operation.
98	Ibid., p. 276.	M. 19	+ double	+	R. motor area.	Fibroma and cyst.	"	+	+	...	...	Astereognosis present for a time; patient well 8 mos. after operation; cyst ruptured spontaneously.
99	Ibid. Not reported; see above.	F. 29	+ right.	+	R. occip. lobe.	Glioma.	"	+	...	+	...	Improvement marked for a time; died 3½ mos. after operation; left hemianopsia present.
100	Ibid.	M. 18	?	?	R. motor area.	Cyst.	"	...	...	...	+ 36 hours	Collapse after 4 hours; very high temp.; no apparent infection; cyst extended back beneath motor area.
101	Ibid.	M. 39	?	+	R. front. reg.	"	"	+	...	+	...	Cyst extended back toward and beneath motor area, opened and drained; celluloid plate over opening.

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1. Schuster. Centralblatt f. Chir., 1902, p. 1016.
2. Gianelli. Il policlinico, July 15, 1897.
3. L. Bruns. Wien. klin. Rundschau, 1897, No. 46.
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14. C. K. Mills. Philadelphia Medical Journal, February 8, 1902.

DISCUSSION.

Dr. F. E. Bunts, of Cleveland, Ohio.

The difficulty in making a diagnosis of this condition was very well illustrated in a recent case I had of a man who had been struck with a switch target several years ago, sustaining an extensive compound fracture of the skull. After removal of depressed bone and a considerable amount of brain matter he was unconscious for several weeks, and then was well for seven years. A few weeks since he was taken with convulsions every three or five minutes, and at the time I saw him this condition had continued for ten days. He could not sleep, and was hardly able to eat.

The convulsions came on originally on the right side, and later on the left. I presumed that the lesion was due to some irritation following adhesion of the scalp to the membranes, but in operating I was surprised to find that there was no trouble of this kind. There was a cyst in the region of the anterior frontal convolution; as soon as it was evacuated the convulsions entirely disappeared, so that the man made a good recovery.

A CASE OF GUNSHOT WOUND OF THE BRAIN IN WHICH THE ROENTGEN RAYS SHOWED THE PRESENCE OF EIGHT FRAGMENTS OF THE BULLET; LOCALIZATION BY SWEET'S METHOD MADE OPERATION INADVISABLE.

With a Description of an Improved Apparatus for Localization of Foreign Bodies.

By W. W. KEEN, M.D., and WM. M SWEET, M.D.,
PHILADELPHIA.

DR. KEEN'S REPORT OF THE CASE.

The following case is put on record as an excellent illustration of the inadvisability at times of removing a foreign body from the brain, and also of the probable rebound of a ball from the inner surface of the skull:

Clarence P., aged fifteen years, of Victoria, B. C., first consulted me on April 9, 1903, at the instance of Dr. O. M. Jones, of Victoria, and of Sir Victor Horsley.

On October 24, 1902, he accidentally shot himself with a 22-calibre rifle. The bullet entered the right side of the forehead a half-inch above the eyebrow at the junction of the middle and external thirds. Dr. Jones saw him half an hour after the accident occurred, and found brain matter and blood oozing from the wound. The boy was collapsed and complained of numbness in the left leg and foot, but could move them. He was taken to a hospital, anæsthetized, the wound enlarged slightly, thoroughly cleansed, and an antiseptic dressing applied. The opening in

the bone readily admitted the tip of the forefinger. Several small splinters of bone were removed, and from under the skin, about one inch *above* the opening in the bone, a sliver of the bullet was removed. The weight of a similar unused bullet is 29½ grains. The sliver weighed 5½ grains (Fig. 1). The eight remaining pieces together, therefore, weigh 24 grains; the largest piece probably weighed about twenty grains. Dr. Jones, wisely, did not probe for the bullet.

At the end of two or three days after the accident the left leg became entirely paralyzed. The first night he was extremely restless, with frequent involuntary movements of the right leg and arm, and on the day after the accident he had half a dozen

FIG 1.

The upper figure is that of a similar bullet to the one causing the accident (weight, 29½ grains); the lower figure is the sliver removed from under the skin above the wound of entrance (weight, 5½ grains). Both are natural size.

very severe epileptiform convulsions, which ceased after a few doses of chloral and bromide, and have not recurred. He gradually improved, never lost his intelligence, the paralysis diminished, and in the course of three months he was able to get about.

Status Præsens. April 9, 1903. There is a small scar just above the right eyebrow. No perceptible aperture in the bone can be felt. There is a little weakness still perceptible in the left leg and foot, as shown by the fact that he balances himself unsteadily upon that foot, whereas upon the right one his balance is good. There is also some increased knee-jerk in the left leg, both with and without reinforcement.

The patient's friends in England had consulted both Sir Frederick Treves and Sir Victor Horsley in reference to his

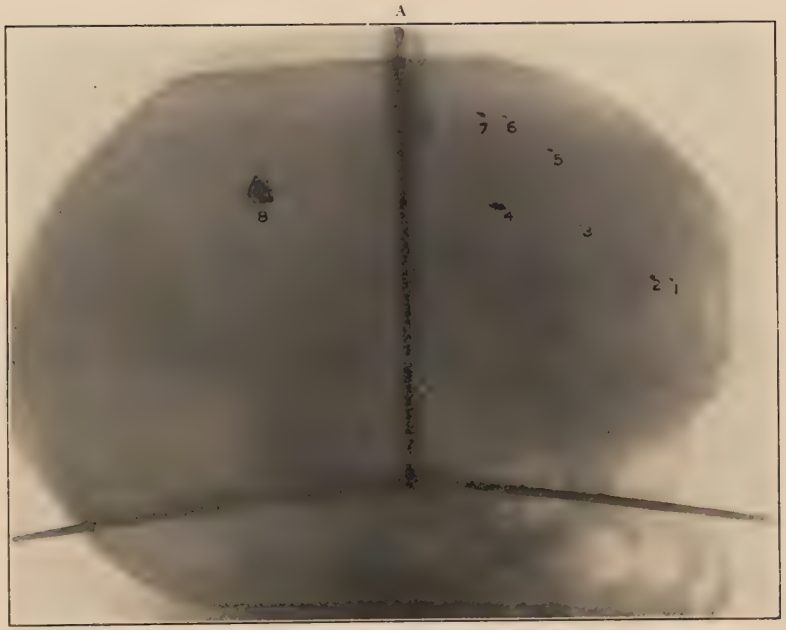
treatment. A brief synopsis of their opinions is as follows: That the position of the retained bullet should be accurately determined; that the ball is now not likely to shift its position; that it is a possible source of future irritation which might result in traumatic epilepsy, and that the advisability of the removal of the ball would depend upon its location.

Dr. Sweet then made some skiagraphs of the head, of which one is presented in Fig. 2. By his method of localization he determined the following facts:

In the brain there are one principal fragment and seven other minute fragments of the bullet, the largest of the latter being about the size of a medium-sized pin's head. Two of these fragments are at the point of entrance. Five of them are scattered through the brain 2.5 cm. to 3 cm. *above* a line running from the wound of entrance to the present position of the ball. The position of each one of these fragments was precisely indicated on the scalp by Dr. Sweet.

After careful consideration of the present location of the bullet and of the boy's excellent recovery, I decided that it would be inadvisable to remove the ball. Of course, the removal of the smaller fragments was not even considered. The following were the reasons for my decision: The ball lay vertically 5 cm. below a point 2.2 cm. to the right of the middle line and 1.5 cm. back of the fissure of Rolando on a line parallel with the middle line (Fig. 3). Dr. Sweet marked not only the point on the top of the head corresponding vertically to the ball, but also a point above the ear which corresponded to it horizontally. This point was, of course, 5 cm. below the level of the top of the head, but on the curved surface of the scalp was 8.3 cm. from the middle line. It was 4.5 cm. back of the fissure of Rolando. In the horizontal plane from the surface of the head toward the middle line the ball lay at a distance of 6.3 cm. (Fig. 4). As it was very important that these two points corresponding horizontally and vertically to the position of the ball should be accurately and permanently marked, with a view to an accurate determination in the future whether any change in the position of the ball had taken place,

FIG. 2.



Skiagraph showing the eight fragments of the bullet.

they were marked in the following way: At the points which Dr. Sweet had marked upon the shaven scalp I injected a few drops

FIG. 3.

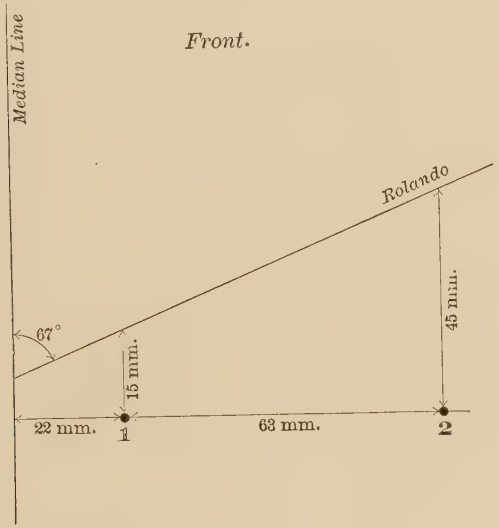
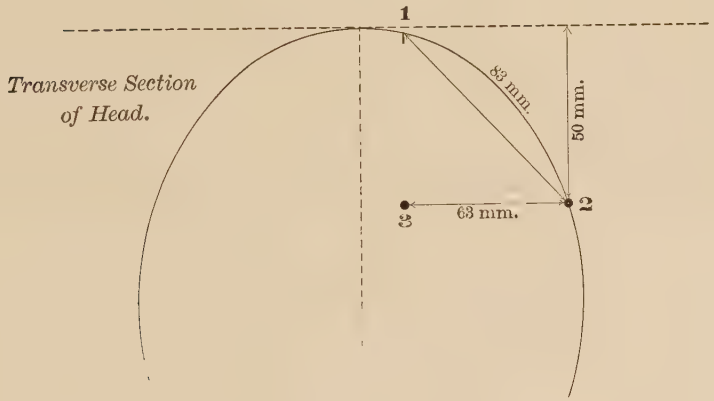


FIG. 4.



Diagrams to show the location of the largest fragment of the bullet. 1. Spot vertically over ball. 2. Spot horizontally corresponding to ball. 3. Site of ball. [NOTE.—The measurement 83 mm. should be from the middle line to 2, and not from 1 to 2.]

of cocaine and then excised a small, round piece of scalp, including the hair-follicles, so that there would be two small permanent

bald spots at these points. As the boy was a very tall, well-developed lad, who had attained almost all of his growth, especially of the head, any later growth will not practically invalidate these measurements.

I wished then to determine the relation of the ball to the lateral ventricle, and for this purpose made a section of a brain hardened in formalin, at a point as nearly as possible corresponding to the figures given above. Comparing this with Dalton's vertical transverse sections through the brain, I found that it corresponded to Plate 15 of series C quite exactly. Applying the foregoing measurements, then, to this figure, I determined that the position of the ball corresponded to the cross marked on a reproduction of this plate (Fig. 5). It will be observed that the ball lies far below the cortical leg centre and just above the lateral ventricle.

The course of the bullet was evidently not in a straight line from the wound of entrance to its present position. This is shown by four facts: 1. The boy states that at the time of the accident he was not looking directly into the barrel of the rifle, in which case the anteroposterior axis of the head would be nearly vertical, but that his head was only moderately flexed. 2. At the wound of entrance, as the ball penetrated the bone, a considerable sliver was taken off the ball by the upper edge of the bone and lay 2.5 cm. above this wound. 3. None of the fragments, except those at the point of entrance, lie in the direct line between the wound of entrance and the present position of the ball; they all lie *above* this line and at a considerable distance above it. 4. If the ball had gone in a straight line from the wound of entrance to its present position, it would not have touched the cortical leg centre at all, though it is possible it might have divided some of the descending fibres from the leg centre. It seems, however, much more likely that the ball passed in a line from the wound of entrance to the point A, Fig. 2, and then was deflected to its present position, and in its course traversed the cortex. It would then have injured precisely the centre for the left leg.

I decided, therefore, that it would be inadvisable to remove the

FIG. 5.

X shows the present position of the largest fragment of the bullet.

ball. In its present position it is doing no harm to the leg; his paralysis has steadily diminished, and in the course of a few months will probably entirely disappear. Any attempt to remove the bullet would cause very much more injury to the brain than the bullet itself does in its present position. Accordingly, I sent the patient home, with the following injunctions: first, as had been advised by Sir Victor Horsley, that he should not begin to study or do much reading until a year had elapsed from the time of the accident, and that he should then study under a tutor for a year, so as to postpone the excitement of a large school for two years from the date of his accident; second, that he should be allowed a greater degree of exercise as his leg improved; and third, that if either of two symptoms arose he should immediately be brought back to me, viz.: in case he developed persistent severe headache or any other symptoms which might suggest impending cerebral abscess; or if he should have a single epileptic attack, I should want to remove the ball immediately. The ball then would be doing more harm than the surgeon, whereas by any present interference the surgeon would do more harm than the ball.

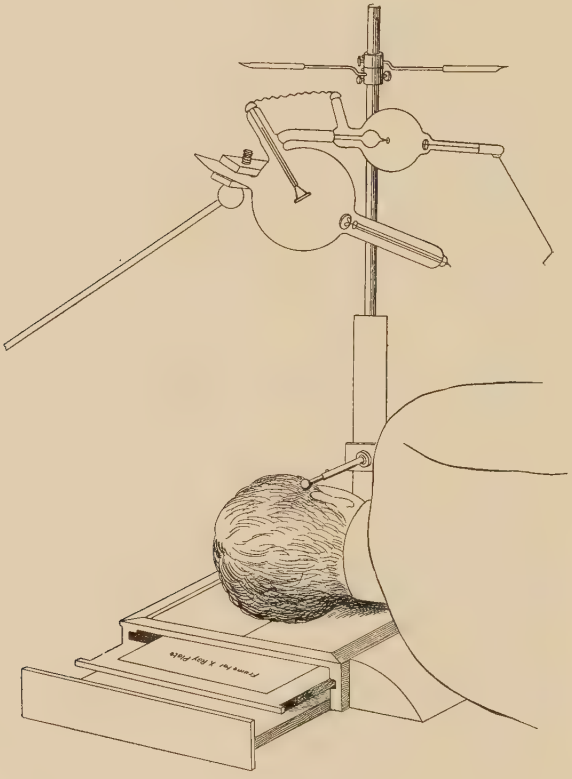
It will be observed that at the time of the accident he had some severe epileptiform attacks, but has had none since. It is not impossible that he may never have any, and it seemed to me wiser to run the risk of a possible future epilepsy than a certain, immediate, and probably very serious damage to the brain by present surgical interference.

DR. SWEET'S REPORT ON THE METHOD OF LOCATING FOREIGN BODIES IN THE BRAIN AND ELSEWHERE BY THE X-RAYS.

The methods employed in locating foreign bodies by the Roentgen rays are all based upon the triangulation of the planes of shadow of the body, with the X-ray tube in two different positions. Measurements of the distance of the crossing of these planes from one or more points marked upon the skin give the exact situation of the foreign substance.

Accuracy of localization depends upon a knowledge of the position of the tube at the two exposures, its distance from the photographic plate, and upon the proper marking of one or more spots upon the skin by opaque substances that will cast shadows upon the plate. A special form of apparatus achieves these results in the most satisfactory manner.

FIG. 6.

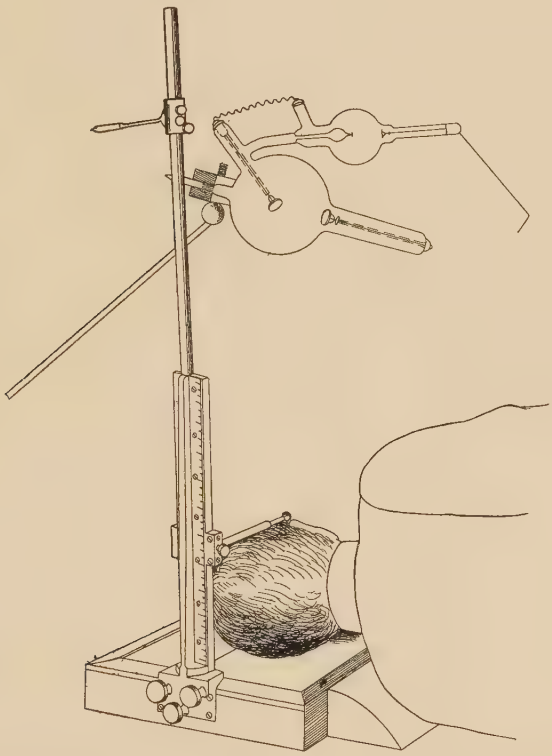


Side view of the indicating apparatus, showing position of tube and indicator, and also receptacle for the photographic plates.

The apparatus for locating foreign bodies is similar in principle to that employed so successfully during the past few years in determining the situation of pieces of metal in the eyeball. I have recently designed a new form of localizer, which is shown in the

accompanying illustrations. It consists of a firm base, the top of which is covered by sheepskin, and is crossed by two steel wires at right angles to each other. A sliding drawer on one side permits the changing of the photographic plate without disturbing the position of the patient. A hollow upright bar attached to

FIG. 7.

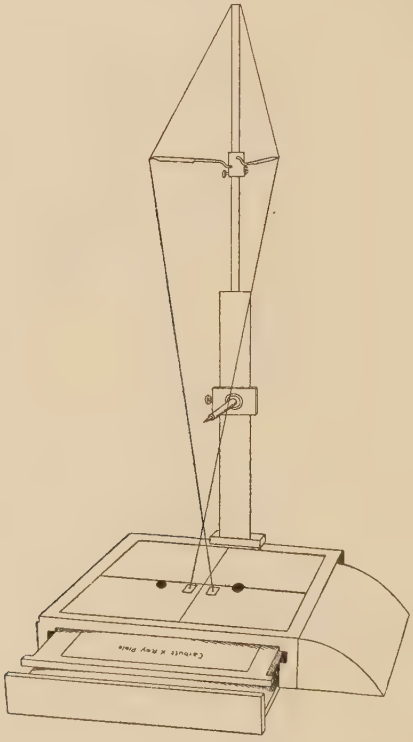


Side view of apparatus, showing indicating rod and graduated upright.

one side of the base supports three movable rods. One rod has its extremity pointed, over which slips an indicating ball. The other rods are employed to indicate the situation of the tube at the two exposures. The centre of the indicating ball is directly above the crossing of the two wires on the base, and its height is shown by a scale upon the upright bar.

The head or other portion of the body containing the foreign substance to be located rests upon the top of the base portion, the cross-wires, previously inked, leaving a mark upon the skin. The indicating rod is lowered until the ball rests upon the skin, and this spot is also indicated with ink. The distance of the ball above the cross-wires is read from the graduated scale.

FIG. 8.



Planes of shadow represented by threads, the point of crossing of which indicates the situation of the bullet.

The X-ray tube is placed from eighteen to twenty inches above the plate, and the distance of the anode of the tube carefully measured. One exposure is then made with the tube directly above or to one side of the indicating ball, and a second plate made with the tube from three to four inches from the first position.

After development the plates show the shadows cast by the cross-wires, the indicating ball, and the foreign body. The distance of the foreign substance from the marks upon the skin of the patient may be determined by plotting upon a flat surface the position of the tube, indicating ball, and the cross-wires at the two exposures, and finding the crossing of the planes of shadow of the foreign body. This method is the one employed in eye-work, and is equally accurate in dealing with other portions of the body, although somewhat more complicated. For this reason I have employed threads to indicate the crossing of the planes of shadow in the new localizing apparatus—a method which has been developed by Mackensie Davidson, of London.

The method of employing the indicating apparatus is as follows: A tracing of the two negatives is made upon a transparent sheet of celluloid, with the point of crossing of the wires corresponding. This celluloid sheet is placed upon the top of the base of the apparatus with the tracing of the shadow of the cross-wires directly above the point of crossing of the wires. The indicating rod is moved to the height it occupied at the time the exposures were made. A thread is now passed from the spot on the celluloid representing the shadow of the indicating ball at one exposure, touches the point of the indicating rod representing the centre of the ball, and is continued the exact distance that the tube was away from the plate when the radiograph was made. A second thread passes in the same manner from the shadow of the indicating ball at the second exposure. The threads are kept taut by lead weights in the hollow upright tube. These two threads accurately indicate the lines of shadow of the indicating ball at the two exposures, and also the position of the tube. If the ends of the threads resting upon the shadows of the indicating ball are now moved to the spots on the transparent celluloid representing the shadows made by the bullet, their crossing will show its position in the tissues in relation to the indicating ball and cross-wires. The distance of this point of crossing from the indicating ball gives the location of the body in the tissues as measured from the spot on the skin at which the ball rested when the two plates were made.

The situation of the bullet may also be measured from the cross-wires. The depth of the body will determine which of the two points is to be chosen in plotting the position of the body for operation. The location of each fragment of the bullet is similarly determined.

The apparatus was made for me by Queen & Co., of Philadelphia.

DISCUSSION.

Dr. N. B. Carson, of St. Louis:

Shortly after the introduction of the X-ray I was called to see a case of gunshot wound of the brain in which the ball entered the occipital region about midway between the occipital protuberance and the mastoid process on the right side, ranging upward and forward. At the time that I saw him the next day we removed several pieces of bone and parts of the ball. Later he developed symptoms of cerebral abscess, and in order to locate the remainder of the ball, which was evidently causing the abscess, skiagraphs were made, one in the longitudinal and one in the transverse diameter, which showed the presence of the ball. In order to locate the ball accurately, careful measurements were made with an ordinary carpenter's square. These measurements enabled us to locate the ball so perfectly that with the first introduction of the exploring needle we found the ball located about an inch from the surface of the brain.

Upon cutting down to the ball we found it surrounded by a small abscess about the size of a medium-sized hickory-nut. The patient progressed favorably for a few days, but ultimately died from septic cerebritis.

This method just described certainly proved very efficient in this case, as we were enabled to locate the ball so accurately as to strike it with the first introduction of the exploring needle; and while I do not think that in each case we could succeed so perfectly, still I am inclined to think that in many cases, if not in most cases, we would be successful in locating a ball in the brain.

CHONDROMA OF SPINAL COLUMN.

By HENRY R. WHARTON, M.D.,
PHILADELPHIA.

F. H., aged thirty-two years, an employé in the Pennsylvania Railroad shop, was admitted to the Presbyterian Hospital July, 1902, with the following history: In October, 1899, while lifting a casting in the foundry, he felt something give way in his back, which compelled him to stop work and he was unable to resume work for four or five months. He complained of pain in the lower right lumbar region, which was increased by standing or stooping and was very marked on attempting to lift even light weights. Upon resuming his work his symptoms were aggravated and he suffered from more or less pain, which he referred to the right post-iliac crest. A year after the original injury he noticed a lump upon the right side of the spine the size of a walnut at the junction of the vertebræ with the sacrum. The tumor gradually increased in size and extended upward, involving several of the lumbar vertebræ.

When examined, upon admission to the hospital, he had an oblong tumor upon the right side of the spine, of firm consistence, apparently attached to the sacrum, vertebræ, and ilium. The growth was not movable and appeared to be firmly attached to the bones. He also presented numerous neurasthenic symptoms, and complained of increased difficulty in stooping and walking, and for the last few months girdling neuralgic pains.

X-ray examination showed a mass attached to the right side of the lumbar spine. Operative treatment was decided upon and a longitudinal incision, ten inches in length, was made over the tumor and the tissues divided down to the muscles; these were separated and exposed the sheath of a firm, cartilaginous tumor,

which was made up of lobulated masses of cartilage firmly bound together, some of which contained small masses resembling bone. With an elevator and bone-cutting forceps the tumor was separated from the lumbar vertebræ, to which it was firmly attached. No spinal nerves were exposed to the dissection. After the tumor had been thoroughly removed the wound was closed with layer sutures. The patient showed no anæsthesia of the parts below the seat of operation, showing that no important nerves had been injured during the operation. The patient made a good recovery and was discharged from the hospital two weeks after the operation with the wound solidly healed.

The subsequent history of the case was satisfactory, the patient reporting some months afterward that he was able to do light work and that many of his neurasthenic symptoms had disappeared.

The following pathological report was made by Dr. J. Dutton Steele, of the clinical laboratory of the hospital:

The tumor is a lobulated mass, measuring 12 cm. in its long diameter and 7 cm. in its central diameter. The lobulation is produced by the composition of the tumor, which is made up of independent, irregular bodies varying in size from a pea to a hickory-nut, but of very irregular shapes. Some are flattened and some are elongated and spindle-shaped, and some are round. They are loosely held together by a sparse connective tissue framework which is poor in bloodvessels. The tumor has no distinct capsule. The union between the separate bodies is a very weak one, and upon handling they separate and fall apart.

Microscopic examination shows that these bodies consist of cartilage which is somewhat atypical, in that the number of cells in the lacunæ is greater than in healthy cartilage, and they are irregularly arranged. The lacunæ themselves are irregularly arranged. The tissue is fairly rich in cellular elements.

The cartilage is of the hyaline variety. In the centre of the larger pieces there is often a deposit of calcareous matter, though nowhere can true bone be found. This attempt at calcification is not found in the smaller pieces.

The tumor is evidently an enchondroma, springing probably from the intervertebral disks. Its peculiar structure, consisting, as it does, of a mass of practically unassociated lumps of cartilage, is very interesting.

Chondroma of the spinal column is a rare affection. I have only been able to find four recorded cases. Weber, in 237 cases of chondroma of bone, reports only one case in which the tumor had its origin in the vertebræ. The following cases have been recorded:

1. Weber[1] records the case of a chondroma springing from the lumbar vertebræ. No further history of this case is reported.

2. Virchow[2] reports a chondroma of the vertebræ removed during life, notable from uncommonness of situation, in a man, aged sixty-five years, who had noticed first eight years ago a plum-sized tumor 7 cm. to the right of the vertebral column and a hand's breadth below the shoulder-blade; growth enlarged externally and also inwardly. Since the beginning of the present year the patient was unable to walk, and since the middle of the year had had bladder paralysis and other symptoms of compression of the spinal cord. The tumor when removed was 29 cm. long. It was closely attached to the seventh and eighth ribs near their necks and had to be chiselled off from the vertebral arches. It projected in between the arches and covered the "Dornfortsätze" of the nearest dorsal vertebræ.

It was a lobulated chondroma with new, small projections springing from the periphery, with a separate eruption of secondary nodular joined together into one tumor.

3. Winch[3] reports the case of a Norwegian sailor, aged nineteen years, in good health, who fell upon the deck and was carried below. After twenty-four hours he was worse and complained of no pain but numbness in both legs. On admission to the hospital his temperature was 95.6° F.; pulse 43; respiration 18. Loss of power and sensation in the arms and legs, absence of reflexes,

[1] Die Exostosen und Enchondromæ. Bonn, 1856.
[2] Berl. klin. Wochen., 1889, vol. xxvi. p. 964.
[3] Winch. Lancet, March 5, 1898.

marked priapism; one pint of urine was drawn by catheter; he died six and one-half hours after admission.

On autopsy there was found a bony enlargement on the left side, joining together the laminæ and spinous processes of the fifth and sixth cervical vertebræ; surface hard and somewhat rough in places, showing evidence of cartilage. On the inside, the growth extended upward as far as the upper border of the third cervical; inside, the growth was entirely cartilaginous and occupied three-quarters of the canal. The laminæ of the third, fourth, and fifth vertebræ were much thinned on the right side from pressure, the cord itself being much compressed for two and one-half inches and displaced to the right side. There was evidence of recent hemorrhage between the growth and meninges.

The microscope showed simple cartilaginous tumor—ossifying chondroma.

4. Föderl[1] reports the case of a woman, aged thirty-five years, housewife, who came to clinic on account of dyspnœa. Family and personal history good; six children living and well; no skin eruption or throat trouble. About three years ago she noticed a small tumor on the right side of the trachea, and as it enlarged an increase in width of the neck and dragging forward of the larynx, and severe dyspnœa were observed.

Physical examination showed nothing but emphysema and bronchitis, the neck greatly increased in anteroposterior diameter and somewhat in lateral diameter. The larynx was pushed and twisted so that the right thyroid cartilage was more in a frontal position. To the right of the thyroid gland, whose isthmus was strongly developed, was a tumor the size of a hen's egg, soft, elastic, fluctuating at its top; deep in the left supraclavicular region was an indefinably limited, firm tumor. The tumor on the right showed no motion with swallowing and appeared generally unattached to surrounding parts. The right thyroid was clearly palpable over its greatest convexity, while the left seemed in its normal situation.

There was no deformity of the vertebræ; their motion was free in every direction. No spinal cord or nerve symptoms; swallowing

[1] Föderl. Deutsche Zeit. f. Chir., 1897, vol. xlv. pp. 154, 159.

difficult; No. 12 bougie passed rather easily, No. 20 with difficulty, but could always be passed.

The patient did not improve, and on the evening of December 18th a low tracheotomy was done under Schleich's solution. The dyspnœa became less marked until December 20th, when she died in collapse following another attack of dyspnœa.

Autopsy showed bronchitis, emphysema, myocarditis, and prevertebral tumor. A tumor, bluish white, 12 cm. long, 9 cm. wide, and 4.5 cm. high, reaching from the upper border of the fifth cervical vertebra to the middle of the fourth dorsal vertebra. In a groove, dividing the tumor in two nearly equal parts, ran the left carotid artery and vagus, while over the greatest convexity of the upper part of the tumor ran the right carotid. The trachea and œsophagus were flattened and displaced; they lay in front of the upper tumor mass. Section showed the tumor to spring from the seventh cervical vertebra. The other vertebræ were unaffected, their periosteum everywhere being intact. The origin of the tumor was in the body of the seventh cervical vertebra. The vertebral canal was normal.

The tumor in the case reported by me presented the typical lobulated appearance, which is accounted for by the unequal growth of the different parts of the tumor. Chondroma of the vertebræ may exist without producing serious symptoms, unless the growth causes absorption of the vertebræ or springs from the intervertebral disks and encroaches upon the spinal cord.

A CASE OF DIFFUSE GONOCOCCUS INFECTION OF THE ENTIRE UPPER EXTREMITY.

With Notes on the Occurrence and Course of Gonorrhœal Septicæmia.

By CHARLES A. POWERS, M.D.,
DENVER.

In March, 1901, I was asked by the family physician to see L. R., a man aged twenty years, whose history was briefly as follows:

On February 21st, never having had a previous gonorrhœa, he applied to his physician for the treatment of a specific urethritis, which had just made its appearance in the usual way. At this time the physician examined the discharge, and found abundant gonococci. The condition was managed in the usual way. There were no bladder or other complications; the man attended to his business as usual, the local condition pursuing an ordinary course. On March 2d, nine days after the onset of the urethritis, he complained of a diffuse pain in and about the right elbow. The elbow was found to be moderately swollen, the swelling and pain rapidly increased. On the following day, March 3d, he went to bed, the elbow symptoms increasing in severity and extending up and down the limb. His nights were exceedingly bad—they were restless and with frightened dreams. During the nights of March 4th and 5th one-half grain of morphine, together with considerable codeine and trional, failed to give comfort. The temperature was irregular, running from 100° to 102° F.; the pulse ran from 80 to 90. He felt definitely ill; he was very nervous and apprehensive.

The patient was first seen by me on March 6th. At this time the right upper extremity was greatly swollen from the wrist to the shoulder, the swelling being greatest at the elbow, which was two and one-half times the circumference of the opposite limb. It was exceedingly tender on pressure all about the elbow, especially tender just above the internal condyle and just in front of and above the external condyle. Movements at the elbow-joint were moderately painful. Fluctuation was not discovered. There was no history of injury, and a minute examination of the entire limb failed to reveal evidence of scratch or prick. On the day of this examination the morning temperature was 100.5° F., the pulse 86 and of fair quality. The patient was very much depressed, exceedingly nervous and apprehensive, irritable, crying and moaning when the limb was touched.

I readily concurred with the family physician in the diagnosis of a gonococcus infection of the limb. It was impossible at this time to say whether the inflammation had invaded the joint. The limb was confined and wrapped in copious pieces of gauze, which were kept wet with lead and opium wash. Tonics were given.

On the following day, March 7th, the patient felt somewhat better. The temperature and pulse were both a little lower, and the general condition of the limb was about the same. A further delay was advised, in the thought that the inflammation might tend to subside.

On the next day, March 8th, both the local and general conditions were much worse. The patient had had an exceedingly bad night, suffering excruciating pain. The limb was much more swollen, and a reddish blush had appeared about the elbow. The tenderness at the points above mentioned became greater. A suggestion of fluctuation appeared. Joint movement at this time gave excruciating pain. The wrist was more swollen and painful, the hands and fingers were puffy. The swelling extended to but not above the shoulder. The urine showed nothing abnormal. The temperature was 103° F., the pulse 90 and of fairly good quality. The heart sounds were clear. There was intense frontal headache.

Free incisions were made under ether, the first just above and in front of the internal condyle of the humerus, this being the point of greatest tenderness and the site of semifluctuation. The incision was long, and was carried to the periosteum of the humerus. It liberated a considerable amount of a thin, clear fluid. From this fluid, as well as from that obtained at other incisions, cover-slips and cultures were made by Dr. W. C. Mitchell, Professor of Bacteriology in the University of Denver. Eight or ten more incisions, each two or three inches long and of varying depth, were made about the joint. All of these liberated thin, clear fluid, except one incision just below and in front of the external condyle. Here there was a moderate amount of thin pus. Some of the incisions simply went through the deep fascia, others went deeper. The elbow-joint was exposed, but not opened, as it did not seem to be definitely distended. All of the wounds were washed out and loosely packed, and the limb dressed in the usual way. Dr. Mitchell reported later that the cover-slips and cultures (method of Wasserman) showed gonococcus. Those from clear fluid showed a pure culture of gonococcus; the one from the thin pus showed gonococcus and staphylococcus. Dr. Mitchell also examined the urethral secretion, which was at this time rather scanty, and found abundant free gonococci, with exceedingly little of the cellular elements. He said that he had rarely seen so little of the latter. I mention this because of the possibility that the almost pure culture of gonococcus in the urethra predisposed to the specific cellulitis of the limb. The family physician, on examining the urethral discharge at its first appearance, had noted the same condition.

On the following day, March 9th, the patient felt better; he was almost free from pain. His temperature was normal in the morning, and his pulse was very much improved. He was still much depressed, and felt definitely ill. The dressings were kept constantly wet with a weak bichloride solution and covered with rubber tissue. The afternoon temperature was 100° F. During the two days following operation the condition remained about the same. The limb tended a little to lessen in size. It remained

exceedingly painful on slight pressure everywhere between the wrist and the shoulder. Two days after operation the throat swelled markedly, the whole neck became enlarged and very tender and painful. The pulse went to 100, the heart sounds became very soft and indistinct, and it seemed that a general gonococcus infection had ensued. The next day the left parotid gland was swollen and painful, the right shoulder and pectoral regions were also involved. The condition of the patient seemed precarious. Under simple local and general measures, however, the swelling of the throat, parotid shoulder, and pectoral region gradually subsided, while the limb proper rather tended to decrease in size. On March 21st, thirteen days after operation, the wounds were healing, with the exception of the deep one near the internal condyle. This was drained by a small rubber tube. It exuded a large amount of thin, almost clear fluid. The patient's general health was beginning to improve. His nights were better. The limb was still tender and painful; the hand and fingers were pretty well swollen—they were quite tender. The patient was still exceedingly nervous and apprehensive—he was much depressed. At this time the pulse averaged about 80; the temperature was normal in the morning, and 99.5° to 100.5° F. in the afternoon. The urethra had been treated daily in the usual way. The urethral discharge had nearly disappeared.

As time went by the limb tended still further to decrease in size, but the elbow-joint remained tender and painful. Three and one-half weeks after operation all of the incisions were closed except the deepest one. This did not completely close until the end of three months. It was capricious; the discharge would almost cease, then it would suddenly become profuse. So, as well with the swelling of the limb, apparently without cause, the elbow and the adjoining forearm and arm would suddenly swell; in a little time the swelling would go down. The wrist and fingers pursued a similar course. At the earliest possible day after the acute symptoms began to subside gentle massage of the wrist, hand, and fingers was commenced, and the patient was urged to begin motion. But motion was exceedingly painful; the patient was

apprehensive, and, in spite of best endeavor, little progress was made. Six weeks after operation the patient was up and about; a little later he sought suitable baths. Not until the end of three months was the limb in condition to undergo systematic massage. At this time the joints were pretty stiff. For months afterward massage and hot-air baths were given; every encouragement was made to increase motion, but, in spite of all that could be done, the limb remained practically unchanged.

At this time—something over two years having expired—the condition is as follows: The circumference of the limb at the middle of the arm and at the middle of the forearm is considerably less than on the opposite side. The shoulder-joint is free and useful; the elbow-joint is nearly fixed—it is at an angle a little within a right angle. Flexion and extension can be made over an arc of perhaps ten degrees. Pronation and supination of the forearm are nearly complete. There is a pretty good range of motion at the wrist-joint. The index finger is fairly useful. The other fingers are pretty stiff. Motion in the thumb is good. The thumb can be made to approximate the index finger very well, and the middle finger quite well. The back of the hand is still a little puffy. There has been little or no improvement during the last few months. The general condition is excellent; the urethra has given no trouble.

At this time we are in possession of sufficient data regarding the secondary manifestations of gonorrhœa to know that practically all of the tissues of the body may be affected. Most often the process invades the joints, but the gonococcus has been recovered from the peritoneum, the pleura, the pericardium, myocardium, and endocardium, the meninges of the brain and spinal cord, the periosteum, the perichondrium, muscles and tendon sheaths, bursæ, fasciæ, the skin, distant lymphatic glands, the parotid gland, the kidney, the blood current. It has been customary to group these manifestations under the general term "rheumatism." It would seem wise to discard this and substitute septicæmia. It would be quite as rational to speak of a metastatic streptococcus infection of the knee-joint as rheumatic as to apply the same term

to a metastasis due directly to the gonococcus. What more absurd than to speak of a gonococcus pleuritis or parotitis as rheumatic!

The designation septicæmia covers all. In its employment, however, it is necessary to differentiate gonorrhœal complication by direct continuity, as cystitis, prostatitis, Cowperitis, epididymitis, periurethral abscess, and the like, and reserve the term for true metastatic inflammation. While the only positive cases are those in which the gonococcus can be demonstrated in the tissues at the seat of the metastasis, it is as rational to consider the ordinary manifestations consecutive to gonococcus urethritis as gonorrhœal as it is to assume a joint affection complicating a staphylococcus or streptococcus infection as being due to the same micro-organism. The rules which apply to the one govern the other.

Joint affections supposedly due to the gonococcus, but not microscopically confirmed, have been reported by numerous observers ; with special emphasis by Claisse,[4] Clarke,[5] Perrin,[8] (diaphragmatic pleurisy, femoral phlebitis), Edington,[10] Emery[25] and Glantenay,[11] Hallé,[12] Ranzier,[21] Raymond,[22] Thibierge, Malherbe,[28] Batut.[36] During the past decade an increasing number of observations have been recorded giving cultural proof that the gonococcus may infect distant tissues in great variety. Thus Bousquet[3] communicates two cases, the second of which concerned a man, aged twenty-seven years, with gonorrhœa of a month's standing, who developed at the level of the internal part of the clavicle a painful swelling which did not extend to the joint. There was no fever, no general reaction; but a week later the joint was seen to be invaded, and on the eighth day fluctuation was discovered. This was incised, and about a spoonful of pus evacuated which contained the characteristic microbe of gonorrhœa. Some days later the head of the clavicle was enlarged, and there was a partial dislocation above the sternum; spontaneous movements were impossible. Immobilization of the arm brought about a cure; but seven months later there developed a swelling, quite large, of the internal extremity of the clavicle and the corresponding part of the sternum. The subluxation was not reduced, and there was no movement in the sternoclavicular joint. The

clavicle had a diameter of three and one-half centimetres, and was covered with bony knobs. Houzé[7] states that the nature of so-called gonorrhœal rheumatism has long been discussed. Certain authors admit a reflex action, of which the point of departure is the urethra; others think it an accidental complication, which they liken to ordinary rheumatism; others that the affection develops from an attack of gonorrhœa, but is due to micro-organisms other than the gonococcus; others freely admit the specific character of gonorrhœal rheumatism. The last theory seems to be the true one. Lindemann, Pétrone, Kammerer, and others have found the gonococcus in the exudate of the affected articulations, and Wertheim has observed the existence of the microbe of Neisser in the blood capillaries of the vesical mucosa; the gonococci were in the capillaries and the little precapillary veins of the submucous tissue—they were not in the little arteries. (This would seem to indicate that the microbe of gonorrhœa acts as do the ordinary infectious agents.) Manley[14] reports an infected elbow-joint in which bacteriological examination showed abundant gonococci. Moynihan[16] says that of twenty-seven of his cases in which a joint effusion was examined, the gonococcus was discovered in only eight, the inference being that the infection is a mixed one. In a case of Paldrock's[17] a man, aged twenty-eight years, developed exudative pleuritis after an attack of gonorrhœa. Many gonococci were found in the pleural exudate. Paulsen reports the case of an infant boy who, two days after birth, developed purulent ophthalmia. In a few days the left knee was affected, and two weeks from birth the metacarpophalangeal joint of the right forefinger, as well as that of the first phalanx, was involved. The general condition was but little disturbed. The effusion from the knee showed only gonococci. Paulsen[18] says that joint metastases in the newborn, due to gonococci, are very rare.

Porter[20] states that it is probable that between 2 and 5 per cent. of the cases of gonorrhœa are complicated by arthritis. From the circulating blood gonococci have been recovered several times, so that we have absolute proof that this organism may cause a

general septicæmia or pyæmia and may produce pus wherever localized. The gonorrhœa may cause metastases in various distant parts of the body. Such localizations are numerous—in the joints, tendon sheaths, and bursæ, pleura, peritoneum, meninges, sheaths of nerves, heart wall and valves, spleen, lungs, kidneys, periosteum, lymphatic glands, subcutaneous tissue, skin, and parotid gland. A patient of Porter's, coincident with confinement, had acute swelling of the metacarpophalangeal joint, ankle, and knee. The gonococcus in pure culture was recovered from the knee-joint contents. In another case, a man, aged forty-two years, who had contracted gonorrhœa eight weeks before, developed moderate fever, swelling of ankle, shoulder, and wrist. In a few days the inflammation subsided in all joints except the wrist, which continued swollen. The hand and forearm were much swollen, the exudation firm and boggy; there was no redness; little heat; motion at the wrist was impossible without great pain. In the anatomical snuffbox and over the extensor tendons at the wrist two apparently fluctuating areas existed. On incision the subcutaneous tissue was "porky," the sheaths of the tendons were filled with a gummy, slightly hemorrhagic exudate. Communication with the joint could be made out. Gonococci were recovered from the pus and granulation tissue in smear and culture. Recovery followed very slowly, with marked tendency to ankylosis. Another case gave the appearance of an ordinary palmar abscess over the head of the fifth metacarpal bone, with superficial redness of the skin and great tenderness. At operation no pus was found, but the adjacent joint was filled with a seropurulent material in which were diplococci decolorizing by Gram's stain. No growth on ordinary media. The girl had contracted gonorrhœa four months before and the organisms were still present in the urethra.

Porter says that the gonococcus apparently localizes itself in the subendothelial tissue, there proliferates, and is carried into the joint cavity by the migrating leucocytes or the desquamated epithelium. In the first few days the organisms are infrequent in the joint fluid. At the end of three days the leucocytes and

endothelial cells appear in about equal numbers, and the gonococci are most abundant, yet are conspicuous for their relative scarcity, occurring in twos and fours within and without the cells. The joint fluid is not a favorable medium for their growth. Young[83] states that all cases of joint effusion in which the gonococcus could be demonstrated at the Johns Hopkins Hospital seemed to demand incision and irrigation.

Considering the early disappearance from the joint cavity, the relative scarcity of the organisms, and the well-known difficulties attending their successful cultivation, it is easy to understand why so many aspirations may be sterile. This may show the necessity for early puncture of a joint for diagnostic purposes.

In another article Porter[40] states his belief that the gonococci are capable of living and propagating in the blood. They may be carried by the blood or lymph stream to any of the tissues or organs of the body, and, lodging there, produce inflammation which may be purulent or non-purulent owing to circumstances which as yet are not understood. True progressive septicæmia is not infrequently due to infection by gonococci.

Senn[23] says that gonorrhœal arthritis occurs in about 2 per cent. of all cases of gonorrhœa. Gonococci may cause general infection and localize in joints without being germinated in a specific urethritis. He believes that the gonococcus does not, as a rule, leave its habitation—the mucous membrane of the urethra or conjunctiva—while it is exerting itself in acute inflammation. It is only when the acute symptoms have subsided that the latent microbe finds its way, through some secondary cause unknown at present, into the general circulation or into the lymphatic system, and subsequently reaches a distant seat.

Ward[29] states that it is obvious that any localized inflammation or sclerosis must be due to toxin locally formed by microbic metastases, while degenerative lesions are due to the general toxæmia, whether absorption takes place from a mucous tract or from such a focus together with secondary metastatic foci. Gonorrhœa is a general toxæmic affection, but the microbes which form the toxin are generally localized on or around a mucous tract. The

microbic infection may extend to the organs communicating with the infected tract, or it may penetrate into the tissues, either by direct extension, as in the invasion of the peritoneum through the uterus and Fallopian tubes, or by a process of growth through the mucous membrane affected.

Smith[39] reports the case of a girl, aged nineteen years, in whom a metastatic abscess developed at the middle of the right arm. There were no signs of inflammation save the swelling. Ten days later another abscess appeared beneath and to the inner side of the right scapula. It also was unaccompanied by pain, heat, or redness. Gonococci were found in the pus. Hallé[42] reports the case of a woman, aged thirty years, who entered the hospital with generalized gonorrhœal infection, with obscure symptoms, going on to hemorrhagic metritis, phlegmonous œdema of the left elbow, endopericarditis, and death. The limb early took on the appearance of a phlegmon of rapid course. The skin was tense, red, and tender on pressure. There was no sensation of deep fluctuation, but a doughy resistance, especially about the olecranon. A serous fluid was withdrawn; it was not frankly purulent. The gonococcus was cultivated from this. An incision was made, and serous fluid, turbid and mixed with blood, escaped. The local trouble subsided, but later a hectic fever marked the invasion of the heart and pericardium. Vegetative endocarditis was the lesion predominant at autopsy.

Braquehaye and Servel[44] say that myositis is not so rare a complication of gonorrhœa as has been thought. They have seen two cases in two years. Colombini[45] reports a case of localization of the gonococcus in the right parotid gland; he thinks the gonococci were carried to it by the blood stream. Johnson reports a case—a baby—in which one of the lesions began as a slight inflammation on the right thumb, spreading over the dorsal surface and around to the palm. The left thumb became involved at the metacarpophalangeal joint, the swelling extending to and over the vola. An abscess of the right elbow-joint developed. Gonococci were found in the pus. The origin of the infection was possibly a gonorrhœal infection of the umbilicus. The author

says it is generally considered that in order to have a general infection there must be (1) a local infection, and (2) a predisposition, as certain patients having a general infection once have it again with each fresh attack of gonorrhœa.

Prochaska[49] reports the case of gonorrhœa in a man, aged twenty-four years, who developed a swelling in the region of the left supraclavicular joint. From blood withdrawn from the left vena basilica cultures were made showing gonococci. Thayer and Blumer,[84] as well as Wertheim,[85] have taught that the gonococci force their way into the epithelium, the connective tissue, and especially into the deeper layer of tissues, where they can cause capillary thrombophlebitis. Perchet and Paolucci believe that they wander by way of the blood and lymph channels. Finger,[54] in reporting on 376 cases of joint complication following gonorrhœa, speaks of blennorrhagic myositis, periostitis, phlebitis, adenitis, and exanthem. Positive cultural demonstration of gonococci proved a portion of his cases. Finger quotes Ghon and Schlag, who affirm that by migrating into the bloodvessels hidden in the pus corpuscles the gonococci can cause the various articular, periarticular, and perichondritic metastases, and that they can set up suppuration in connective tissue. Drobny, quoted by Ward,[66] states that the gonococci are often extracellular; they are found free as well as in the pus cells. Ward says that in exceptional cases the gonococcus can make its way into the circulation, and so reach the cardiac valves and other remote situations. In an individual whose phagocytes are exceptionally susceptible to toxic influences the urethral infection would be imperfectly restrained, and thus become very acute. Much toxin would be formed and absorbed. The invasion of the tissues by the microbe would also be very active, and the resistance of the guardian wall of inflammatory cells imperfect. The microbes would thus grow into the lymphatics and small veins, and by one route or the other gain the circulation. Here the toxin would have preceded them and already inhibited the leucocytes generally, so the microbes would be enabled to grow in the cardiac valves should they offer a suitable nidus, or might be carried to the peripheral circulation,

and there be stranded, like sticks and leaves in a back water, in the looped terminal capillaries of the synovial membranes and the slender vessels of the periosteal tissues and tendons. A case of gonorrhœal arthritis of the wrist of an infant (newborn) in which the microbe was found, occurring two weeks after gonorrhœal ophthalmia, gives added evidence of the possibility of a general infection by the gonococcus arising from a local focus other than the urethra. Drobny thinks it possible that the extracellular position of the cocci may be due to paralysis of the leucocytes by toxins, thereby rendering them incapable of surrounding the cocci.

Breton[68] quotes Leloir, who insists on the various infectious forms of gonorrhœa. In a healthy individual the local effects are sometimes the only ones noticed. The general phenomena are unimportant. But if for any reason the vitality of the patient is below par—from hereditary or acquired diatheses, poor hygienic conditions, etc., the means of resistance are diminished and conditions are favorable for the receptivity, penetration, and multiplication of the organisms. According to the degree of physiological decadence the disorganization of the cells is more or less extensive, and the development of the infectious agent more or less rapid. Soon the blood, the organs, the whole economy will be invaded by its toxins, and there will be a general gonorrhœal infection. Breton cites two cases: The first that of a young man, aged twenty-one years, whose gonorrhœa was followed by a generalized infection, manifesting itself in ganglionic and splenic adenopathy, endocarditis, and infectious periarthritis, and a polymorphous erythema (maculo-papulo-vesicular). The attack threatened life, but recovery ensued after two months. The patient suffered from vague pains, especially in knees and elbows, swelling and redness at the level of the metacarpophalangeal joint of the right ring (fourth) finger, myosalgia. At the level of the olecranon and over the internal malleoli there were small ulcerating pustules. The gonococcus was demonstrated. The second patient was a man, aged twenty-five years, whose gonorrhœa was followed by epididymitis, infectious periarthritis, and slow general infection. The evolution of these symptoms took three months. There was

no fever, but a definite localization in the testicle first, and then in the synovial membranes of the joints. Breton says that organic lesions are the more tenacious the more insidious their appearance, and the duration of the discharge seems directly proportional to the intensity of the general phenomena.

Robinson[71] notes six fatal cases of gonorrhœal origin. Four were under his care, while one was communicated to him by De Fleury and one by Hawkins. In five of these endocarditis caused death; meningitis killed the other. The case which Robinson here specially reports was that of a man, aged thirty-two years. The attack at first seemed like the onset of some acute infectious disease. Delirium developed, then coma; death occurred within four days of the time when he was first taken ill. There seemed to be a condition of general hyperæsthesia. The temperature varied from 99° to 105° F. On the third day the whole body was dotted with purpuric spots, and it became evident that the patient was suffering from intense blood poisoning, although no source of infection could be detected. At autopsy gonococci were found in the urethral pus, and the writer is satisfied that the urethra was the original source of the infection. The fluid in the joints was not examined.

I saw a similar case at the County Hospital in Denver some years ago. A woman, aged thirty-five years, was admitted, with general arthritic pains and a swollen right knee-joint. There was a gonorrhœal history, and gonococci were recovered from the vaginal discharge. On the day after admission she developed symptoms of endocarditis, and died within forty-eight hours. An autopsy was not permitted. While the case lacks bacteriological confirmation, I made no doubt at the time that death was due to gonorrhœal infection. Councilman[82] reported a death from gonorrhœal myocarditis in 1894.

Gershel,[74] in reporting a case of subcutaneous abscesses due to the gonococcus in a child, aged two years, looks upon it as one of infection by way of the lymphatics. He found but eleven cases in literature in addition to his, most of them having been collected by Young, who, in a most interesting and valuable article, cites

cases of pyonephrosis (single and double) and of diffuse peritonitis culturally confirmed by the presence of the gonococcus.

Kienboeck[77] reports on a woman, aged twenty-six years, in whom primary gonorrhœa was followed by paralysis of the right arm, with infiltration of the region of the olecranon, crepitation in the shoulder, changes in the skin and nails. Nobl[79] reports on twenty-three cases of severe gonorrhœal synovial metastases. Of these eighteen underwent bacteriological investigation. In thirteen of these the gonococcus was proven, while eleven times a seropurulent effusion was sterile. Hunner and Harris report on seven cases of acute gonorrhœal peritonitis, in four of which gonococci were found. All seven cases underwent operation. There were two deaths. Barbiani[81] saw polyarthritis in a man, aged thirty-six years, who was diabetic. Gonococci were recovered from the venous blood.

Seelig[41] believes that muscular atrophy sometimes follows gonorrhœa, and divides the so-called gonorrhœal nerve affections into three groups:

1. Neuritis or polyneuritis.
2. Affections of the nerve roots.
3. Meningomyelitis: (*a*) acute, and (*b*) chronic.

Balzer[26] refers to the researches of Moltchanon and De Christmas in demonstrating the intensity of the action of gonotoxin on the spinal cord and brain.

Brewer[65] says that gonorrhœal adenitis shows but slight tendency to suppurate, and that when suppuration does occur it is probably due to a mixed infection. The question as to whether the gonococcus alone can produce pus seems to be unsettled. A few cases gathered from literature by Young, together with added instances studied by him in the clinic and laboratory of the Johns Hopkins Hospital, point to the probability that it may. Welch[86] says it is a genuine pus producer.

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THE LESIONS THAT AUGMENT THE DEVELOPMENT OF TETANUS AND OTHER INFECTIONS IN GUNSHOT WOUNDS.

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The object of this paper is not so much to discuss the lesions that predispose to infection in gunshot wounds as it is to point out the histological anatomy of such wounds, as revealed by microscopic sections.

Gunshot wounds are often referred to as punctured, penetrating, or perforating wounds such as are apt to be inflicted by any blunt instrument wielded with sufficient force. This idea is correct only within limits. A punctured wound from a blunt instrument exhibits lacerations and contusions in and immediately around the area of injury, while a punctured wound by a bullet propelled by a certain degree of velocity will exhibit loss of tissue and lacerations not only in the immediate vicinity of the channel made by the projectile, but lesions will appear in the parts beyond to an extent dependent upon:

1. The sectional area of the bullet.
2. Its velocity.
3. The resistance encountered on impact.

The greater the velocity or sectional area of the bullet the greater will be the lesion in the surrounding tissues, and in those instances when the velocity is great and the resistance on impact is unyielding, as in the case of a ball colliding with the shaft of a long bone like the tibia or femur, the destructive effects are enormous. These effects are so extensive that the wounds produced in this way are referred to as explosive wounds or wounds showing explosive effects.

It is not necessary to resort to the latter class of wounds to study the lesions that are thus created; in fact, microscopic sections of gunshot wounds in soft parts reveal all the characters of gunshot wounds sufficiently for the purpose of study.

Aside from microscopic studies of the contused area we know that the tissues are injured beyond the track of the bullet by certain appearances which reveal themselves in the history of such cases. Thus, slough often occurs in the skin beyond the margins of entrance and exit. Later, when healing is well along, a cord marking the track of the bullet, running in the soft parts between the two external wounds, is easily discernible to the sense of touch.

In recent studies upon the character of the various tissue lesions Strick has shown that hæmatomata especially predispose to the development of infections; he was able to show that hæmatomata in wounds increase the susceptibility to infection from tetanus a thousand times more than exists in a clean incised wound. More recently we have demonstrated that burn, as in toy-pistol wounds, adds to the susceptibility, and that animals infected in a cut made by a red-hot knife with a certain spore mass of tetanus died in every case, while animals similarly infected in incised wounds made with a cold knife lived in every instance.

Dr. Lardy, in the Greco-Turkish war, in commenting upon the conditions found in ninety-five infected gunshot wounds out of a total of 469 cases, gives the following:

Pieces of cloth in wound carried by the ball	13
Hæmatomata	3
Fragments of bone acting as secondary missiles	29
Lodged balls	22
Cause of suppuration undetermined	28
Total	95

In this estimate we must conclude that the percentage of cases showing hæmatomata is small, in view of the twenty-nine cases which presented fragments of bone lodged as secondary missiles. Each one of these fragments was displaced by the force of impact, which, of necessity, possessed energy enough to rupture the tissues about it, and there was doubtless a corresponding degree of hæmatomata (?).

That suppuration should have been so seldom attributed to the lodgement of either the ball or the pieces of clothing seems to accord with the observations of Strick, who experimented with a known spore mass of tetanus with which he contaminated his bullets before firing into rabbits. The animals died of tetanus in every instance. In order to estimate the influence of implantation of foreign bodies in wounds devoid of the lesions which come with the mechanical effects of a missile while traversing tissues he experimented with four different kinds of foreign bodies, viz., bullets, splinters, cloth, and paper. Out of seven rabbits in which the ball was infected with the tetanus culture and implanted in a simple incision in the muscles of the thigh, five recovered and two died. Six rabbits inoculated with splinters similarly treated and planted in clean cuts all got well. When placed on cloth and buried in clean incised wounds the tetanus killed two rabbits out of six, and but one rabbit out of six died when the culture was placed on filter paper which was buried in a clean wound. These results compared with those of Strick, in which every animal died when shot with infected balls, show that the lodgement of foreign bodies *per se* adds but little to the susceptibility to infection, and that the special lesions from a ball animated by a certain degree of velocity as it passes through tissues are necessary to augment the susceptibility to infection. As already stated, these lesions partake of the nature of hæmatomata.

The influence of velocity in creating hæmatomata in soft tissues was the subject of certain experiments that prove of value. We fastened a rusty nail of thirty-two calibres to the end of a board, and, using the board as we would the handle of a hammer, a perforated wound was inflicted in the thigh of a cat by delivering a sharp blow. In the other thigh we fired a thirty-two calibre bullet at a distance of one foot. After death a block from each wounded area showed no gross appearances of hæmatomata about the perforation caused by the nail, while hæmatomata extended in the interstices of the muscle fibres for a distance of 5 mm. about the bullet wound in the opposite thigh. The influence of velocity was again shown by firing into cats with the Krag-Jörgensen service

rifle. We give below the measured distance of the hæmatomata as observed away from the channel made by the bullet:

Krag-Jörgensen bullet,	cal. 0.30,	v. 835 f. s.,	hæmatomata . . 8 mm.
" "	" 0.30,	v. 1138 f. s.,	" . . . 12 "
" "	" 0.30,	v. 2200 f. s.,	" . . . 23 "

The areas as influenced by this bullet in the order given would therefore be as follows:

V. 825 f. s.	201 sq. mm.
V. 1138 f. s.	453 "
V. 2200 f. s.	1664 "

It is thus seen that the extent of hæmatomata increases with the velocity of the projectile to a marked degree. The fact that destructive effects in the hard bones increased with velocity from the dispersion of the energy of the projectile was always appreciated, and the same factor doubtless accounts for the extent of the lesion in the soft parts. Again, we know, as far as bone tissue is concerned, that the destructive effects increase with the sectional area of the bullet. That the same is true of the soft parts is shown below. The experiments were conducted by firing into the gluteal region of cats with the Springfield and Krag-Jörgensen rifles, the velocity of the bullets remaining approximately the same. The measured distance of hæmatomata from the channel of the bullet is:

Springfield rifle-ball,	cal. 0.45,	v. 1301 f. s.,	hæmatomata . 30 mm.
Krag-Jörgensen rifle-ball,	cal. 0.30,	v. 1138 f. s.,	" . . 12 "

The thoroughness with which tissues are often infected by the energy of an unclean bullet has a great bearing upon the susceptibility to infection. This is well shown by firing bullets of varying velocities and calibres into animals in which the skin has been well rubbed with finely powdered charcoal. The figures in millimetres represent the distance the charcoal particles were found in the tissues away from the channel caused by the bullet:

Pistol ball, 0.32	cal.,	v. 300 f. s.	3 mm.
Krag Jörgensen bullet, 0.30	cal.,	v. 2200 f. s.	10 "

If we compare the distribution of carbon particles as influenced by the sectional area of bullets, the velocity being about the same, we find the following:

Krag-Jörgensen bullet,	0.30	cal., v. 1138	6 mm.
Springfield bullet,	0.45	cal., v. 1301	17 "

This result corresponds closely with that obtained by Koller and Karlinski, who found that foreign bodies, such as carbon or particles of cloth, were driven a distance of ½ to 2 cm. from the channel track, while experimenting with the Swiss model reduced calibre rifle.

Among the lesions of gunshot wounds which predispose to infection another important factor is the fissuring extending laterally from the channel track and the disturbance of the muscle or tissue fibres which is apt ultimately to lead to necrosis of the same. Microscopic section shows the muscle fibres torn, twisted, and otherwise distorted at a distance of from 3 mm. to 10 mm. from the channel, varying with the velocity and sectional area of the projectile.

The foregoing has a very important bearing upon the rational treatment of gunshot wounds. In view of the extent to which extraneous matter containing bacteria may be driven into tissues, it is hopeless to attempt to disinfect the channel made by a bullet. Extended experiments were conducted by Müller and Koller in which they essayed various methods of treatment of the channel track in gunshot wounds caused by projectiles that were primarily infected, namely:

1. Controls, for which nothing was done.
2. Those treated with a glass drain.
3. Those treated with an iodoform gauze drain.
4. Those irrigated with 5 per cent. solutions of carbolic acid.
5. Those treated by rubbing with a cotton mop soaked in tincture of iodine.
6. Those treated by cauterizing the wound.

However treated all the wounds were dressed with a clean, sterile dressing. The results showed that the animals treated by simple dressing did best of all and that those treated by radical measures, such as swabbing with iodine and the application of the thermocautery, gave evidence of suppuration in every instance.

DROWNING OF PATIENTS IN FECAL VOMIT DURING OPERATIONS FOR INTESTINAL OBSTRUCTION AND SEPTIC PERITONITIS.

By E. WYLLYS ANDREWS, M.D.,
CHICAGO, ILL.

My attention was sharply called a few years ago to a kind of accident hitherto unknown to me—the loss of life by drowning in fecal vomit—and I reported two such cases to the Chicago Surgical Society, 1901.

A patient may be killed by drowning in fecal vomit while unconscious on the operating-table or semiconscious after anæsthesia. The utter collapse which follows ileus of any origin favors this accident of flooding the air-passages, so that it probably occurs rather often. I do not wish to invoke this as a sole cause of sudden death or to ignore such other causes as toxæmia, myocarditis, embolism, or pulmonary œdema, but will describe two plain cases of death by suffocation which I have seen myself.

Case I.—A young man, aged eighteen years, patient of Dr. McGaughey, was operated upon for acute suppurative appendicitis at the Mercy Hospital. The general peritoneum was infected, and a large amount of pus was removed, after which the cavity was irrigated and a Mikulicz gauze drain inserted. This patient was returned to his room in fair condition. About fifty or sixty minutes after the operation I visited his room, where he had been attended constantly by a nurse. His consciousness had not returned, and nothing unusual had occurred, until, a moment before I chanced to reach his bed, he choked a little and ceased breathing. He was cyanotic and gasping as I entered, but did not vomit or retch. The

pulse was full. Separating the teeth and drawing the tongue forward, I found his nose and mouth full of fluid fecal vomit. None had escaped, and there was no cough. I lowered the patient's head by hanging his shoulders over the side of the bed, when large volumes of brownish fluid ran in streams from his mouth and both nostrils. When this ceased running his body was rolled and then still more elevated, and artificial respiration kept up. The pulse soon ran down, and he died without ever breathing naturally again or seeming to get any oxygenation from the forced breathing. He was practically dead when I saw him, although the heart beat a moment longer. Such a death might have been thought due to the anæsthetic had it occurred on the table. Of course, it is possible to assume that it was a cardiac case or a pulmonary embolism, and the flooding only an incident, but I believe it to be one of drowning, for reasons stated below.

Case II.—An infant patient of Dr. McCleary had complete mechanical obstruction for which I was called to operate, my diagnosis being intussusception of the ileocæcal valve. While making preparations for this operation, about twelve hours after the obstruction began, slight cyanosis and choking were noticed in connection with fecal vomiting, which was rather constant. About sixty seconds after the patient was laid upon the table, and almost with the first breath of ether inhaled, it ceased breathing and became suddenly cyanotic. The pulse disappeared, and when the body was inverted immense quantities of brownish fluid ran from the nose and mouth. Artificial respiration failed to restore this patient. An autopsy showed our diagnosis to be correct, the invagination of the valve being easily reducible.

After reporting these cases several Fellows of this society brought me verbal reports of similar deaths which they had personally witnessed. Dr. L. L McArthur allows me to quote two instances of drowning by vomit in his service at the Michael Reese Hospital. One of these occurred at the beginning of anæsthesia, and the other just at the moment of making the abdominal incision. Both died quickly, with sudden failure of respiration and an immense out-

pouring of fecal fluid from the nose and mouth, so that the operator was convinced that they were cases of suffocation or drowning. Dr. A. D. Bevan has kindly furnished me with another instance of this accident. This death occurred during an operation for gastro-enterostomy under chloroform anæsthesia. The patient dying on the table with the air passages flooded with brownish fluid which he apparently had lost the power of expelling.

I am also indebted to Dr. Wm. E. Morgan for three typical cases seen by him. One, a corpulent man, during an operation for intestinal obstruction, suddenly regurgitated a fluid of brownish color which was drawn into his trachea, causing quick suffocation. I chanced to be present and saw this death. A second case was one of gastric carcinoma operated upon by Drs. Fenger and Morgan, which died on the table by this same outpouring and drowning accident. The stomach had not been washed out.

A third case of Dr. Morgan's while being operated upon in a suburban town for bowel obstruction had, to quote his language, "a fecal explosion," strangled and died on the table with the lungs full of fecal vomit.

I am now, therefore, more than ever confirmed in the belief that this accident of drowning is an ever-present danger in septic laparotomies. If I may be allowed to frame certain hypotheses, I will explain the mechanism of this accident as it presents itself to me. We will assume that the careful surgeon has washed out the stomach in these cases, yet starting with an empty stomach does not insure its remaining empty. Nothing has impressed me more than the enormous collections of fluid, in large and small bowel obstructions, which accumulate in the intestine. I have observed this particularly in opening the abdomen in late cases of obstruction. Although everything taken by the mouth is vomited, still in these cases fluid accumulation goes on so that the paralyzed and distended bowel contains much more liquid than gas. In a few cases where I drained the bowel by artificial anus or to facilitate handling I have been amazed at the quantity poured out. Sudden access to the stomach from this great receptacle takes place, in my opinion, when the tonus of the pylorus and cardia is relaxed by extreme

depression. Probably ether and chloroform toxæmias added to septic toxæmia abolish some reflexes ordinarily present, so that throat irritability is also lost, and no spasmodic expulsion occurs when the trachea and bronchi are flooded. Assuming this throat paralysis as probable, the ease with which a narcotized patient can be drowned in fluid vomit is appalling to consider.

The toxicity of this matter is so intense that even in the throat some absorption may take place, but unless this poisonous influence is exerted locally there is scarcely time for any effect from it. The viscidity of the fluid, however, adds to its deadly choking influence when it is forced into the smaller bronchi. There is scarcely any chance that such sticky, turbid matter can be expelled or drained out from the lung as pure water is known to do with changes of posture.

Conclusions. 1. Flooding of the air passages by fecal vomit is a real danger, and probably has caused many unexplained deaths.

2. Resuscitation is impossible or very difficult.

3. The fluid may flow by gravity through the relaxed stomach sphincters directly out of the intestines, where it has accumulated in enormous quantities.

4. The accident occurs with great suddenness and with a stomach supposedly empty. The suffocation may be so complete that no outcry is made, and may not be noticed by the attendant.

5. It may occur as late as an hour after anæsthesia, or at any time until consciousness is restored.

6. We have no evidence that it can occur during consciousness even *in extremis*.

7. After septic laparotomy patients when returned to bed should be watched, without even momentary intervals, to full consciousness.

8. A suggestion made to me by Dr. McArthur that as many as possible of such cases be operated upon under cocaine anæsthesia seems to me sound in the light of the above report, as well as for other reasons. I have tried both spinal and local cocaine anæsthesia in several recent cases, and am convinced that it is a life-saving measure.

REMOVAL OF A HEAVY SILK LIGATURE FROM AROUND THE RIGHT PNEUMOGASTRIC NERVE.

Clinical Symptoms before and after Removal.

By CHARLES A. POWERS, M.D.,
DENVER.

Mr. X., a young gentleman, aged twenty-five years, first consulted me in March, 1900. As a boy he suffered from enlarged glands on each side of the neck. These at times suppurated and were opened; at times they broke and discharged spontaneously. His first radical operation was in 1891, at which time Dr. W. T. Bull removed a large mass from the left side, the wound healing promptly. There was but slight further enlargement of the glands on that side, but continued trouble with those on the opposite or right side. No further operation was performed, however, until the latter part of January, 1900, at which time the right side of the neck was operated upon in another city. At that time there was a mass about the size of a hen's egg. The best one can judge from the account given by the patient, the operation was a difficult one—there was much bleeding, and it was said that, to check profuse hemorrhage, heavy silk ligatures were passed around the deep vessels by means of an aneurism needle. The patient says:

"My physician told me that I went into collapse on the table, and that he was unable to complete the operation. When I came out from under the anæsthetic there was severe, continued, spasmodic coughing, great distress, and complete loss of voice. Great swelling of the neck and high fever followed the operation. Loss of voice continued for two or three weeks. During the first few days there was a constant, irritable, distressing cough. This

gradually subsided, but any pressure in the region of the wound excited severe coughing."

When the patient came to see me some five weeks after this last operation there was found an old scar on the left side of the neck and a recent scar on the right side. The latter extended from a little below the mastoid two-thirds of the way down to the collar-bone. There was an opening at the upper part of this scar and another opening at the lower part, each discharging a moderate amount of thin pus. Irrigation showed the sinuses to communicate. There was a small bunch of glands at the upper part of the neck on the right side, and two or three small segregated glands below and behind the angle of the jaw on the left side. The scar on the right side of the neck was exceedingly irritable; even slight pressure at any point in its upper third occasioned severe, spasmodic coughing. Coughing was also excited by irrigation. Unsuccessful attempts were made to heal the sinus. It was very gently scraped under cocaine; but this excited so much coughing that it was thought wise to desist. A heavy silk ligature having a lumen half the diameter of a lead-pencil came away in March, and another came away in June. Still the sinus did not heal. At this time I advised the patient not to have a radical operation because I feared that dangerous coughing might come on while he was under the anæsthetic. It was thought that if further ligatures were present they would probably come away spontaneously. In the autumn of the same year the patient consulted Dr. V. P. Gibney in New York, who, together with Dr. H. T. Pershing, of Denver, concurred in the thought that delay was preferable to operation.

The patient spent the last part of the year 1900 in the East. On January, 20 1901, he reappeared in my office, the sinus having persisted. He said that three weeks before, while at his home in Kentucky, the end of a heavy silk ligature presented at the upper end of the sinus. His physician there endeavored to withdraw it, but it was firmly fixed, and even moderate traction on it set up extreme and long-continued coughing. I seized the end of the ligature with an artery clamp, and pulled pretty hard, but the

ligature did not come away, and the traction occasioned intense coughing, pain, shortness of breath, and vomiting. The patient sank to the floor with a cyanosed face, hardly able to get his breath. The pulse was slow and full. It was some five minutes before his condition became good. At this time it seemed probable that the ligature was around the pneumogastric nerve; and Dr. H. T. Pershing, Professor of Nervous and Mental Diseases in the University of Denver, was asked to see him in consultation. Dr. Pershing concurred in the diagnosis and joined in recommending operation under a general anæsthetic. This was carried out at St. Luke's Hospital on January 22d, the anæsthetic being administered most carefully by Dr. Edward Delehanty. Ether was deliberately chosen and started, but violent coughing with embarrassed respiration accompanied it, so chloroform, very slowly and carefully given, was substituted. Under the chloroform respiration was good. A long incision was made with the sinus opening at its centre, and very careful dissection carried out. In the depth of the wound, beneath the sternomastoid muscle the loop of the ligature was encountered. This lay one-half inch above the great cornu of the hyoid bone, two inches behind the angle of the jaw, one and one-half inches below the apex of the mastoid process. The ligature lay in a large mass of granulation tissue. The slightest interference with this portion of the wound and the slightest traction on the ligature brought on alarming coughing and cyanosis. With extreme care the loop of the ligature was cut and the ligature itself withdrawn. It was tied in a hard, square knot; it had a lumen about the size of a lead-pencil. The pneumogastric nerve itself was not definitely recognized. The angles of the wound were sutured, the middle part gently packed. The after-course was smooth and uneventful; the wound was completely and permanently healed in three weeks. For some time after the removal of the ligature firm pressure at its site occasioned moderate coughing; this, however, grew gradually less, and two or three months after operation the patient was nearly free. He has never, however, become completely free. I have seen him from time to time, and last examined him in March of the present year. At this time

deep pressure at the place where the ligature was found made him cough a little. There were some small glands at the upper part of the neck on both sides, but not enough to seem to warant operation. The patient was living a fine outdoor life, riding after cattle a large part of each day. His lungs were examined by Dr. S. G. Bonney, and found to be free. His hard muscles and generally rigorous physique betoken excellent health. The sinus of the neck has remained closed.

While I was unable anatomically to recognize the pneumogastric nerve in the wound at the time of operation, I have no doubt[1] that it caused the structure around the nerve in which the ligature lay. The symptoms during and after the operation at which the ligatures were applied, together with the physiological symptoms accompanying pressure or traction, and the lumen of the ligature itself, seem to stamp the diagnosis with a fair degree of certainty.

[1] The following letter strengthens this opinion:

DENVER, April 1, 1903.

I have never had any doubt that the pneumogastric nerve was included in the ligature removed from the neck of Mr. X. The location of the irritable spot, the violence of the respiratory spasm, even when under chloroform, the vomiting, the history of onset immediately after operation, and the prompt subsidence after removal of the ligature, all support this opinion.

HOWELL T. PERSHING, M.D.

NERVE INJURIES ABOUT THE SHOULDER-JOINT.

By F. E. BUNTS, M.D.,
CLEVELAND.

Injuries about and to the shoulder-joint have so often been complicated by nerve injuries, and subsequent paralysis, and atrophy of various muscles, that I have considered it worth while to attempt to group these results under distinct heads and to point out, so far as practicable, the distinguishing features of the individual nerve lesions.

The distinguishing clinical features of all these injuries is the striking deformity that results from muscular atrophy and the loss of function dependent upon the nerve injured and the muscle involved.

The injuries to which I desire especially to call attention are:

1. Paralysis of the circumflex nerve.
2. Paralysis of the long thoracic nerve.
3. Paralysis of the suprascapular nerve.

It is true that two or more of these injuries may exist at the same time, and, while it is not always possible to separate their symptoms along clear and definite lines, yet there are certain symptoms which clearly belong to the individual nerve injured; and to these I wish to call especial attention.

1. Paralysis of the Circumflex Nerve. This is by far the most frequent injury of the three, and has been so long recognized and so carefully described that I can only hope to present its history in a systematic way that may possess some advantage. The traumatic paralyses of the arm were already known to the physicians of ancient times. Galen, in his *Officina Medici*, refers to Erasistrete, who, 300 B.C., made mention of this complication

in luxations of the shoulder; and among the Arabian physicians Avicenna, in his *Cannons*, also wrote of this paralysis. In later years the works of Boerhaave and Van Swieten contain references to this affection. The isolated paralysis of certain muscles, such as the deltoid, consequent to a trauma, seems, however, not to have been specifically observed by these writers. Desault, at a much later date, mentions two cases of complete paralysis of the deltoid, one of which was permanent and the other disappearing in fifteen days. Both of these followed a luxation of the shoulder. Baron Boyer next (in 1822) reports three instances of this isolated paralysis, also the result of shoulder dislocations. In two of these the application of irritating substances is credited with having effected a cure, while in the third case the paralysis persisted. In this last case the deltoid is said to have lost the power of contractility—to have been considerably flattened, and the movements of the shoulder are stated to have been lost.

Soon after, the occasional occurrence of deltoid paralysis gradually came into prominence and received increased recognition. Malgaigne (in 1830) particularly mentions the paralysis of the deltoid among the traumatic paralyses of the arm, and also considers the etiological factors and causation of these complications. Arloing de Nevers (in 1832) published an observation of a dislocation of the shoulder, in which the head of the humerus, when reinstated into the glenoid cavity, could not be held in position owing to the paralysis of the deltoid. The contractility of the muscle was regained by a large blister applied over this area, and the reduction then definitely accomplished.

Paola Cumano next (in 1833) reports two observations in which a paralysis of the deltoid followed a luxation of the shoulder-joint. The paralysis in both of these instances is ascribed to a prolonged pressure by the head of the humerus upon the brachial plexus, and especially upon the circumflex nerve. At this time the writings of Petit, Ollivier, Jobert de Lamballe, Nélaton, and others mention this affection, Petit attributing its causation to the use of the door and ladder, which were occasionally used by many surgeons in the reduction of the luxation.

Blandin, in his classification of traumatic paralyses of the arm appearing at this period, accords the paralysis of the circumflex nerve a separate position, and gives it precedence. Since then the frequent occurrence of isolated deltoid paralysis has been commonly remarked upon, and is frequently mentioned as a sequel to dislocations of the shoulder.

Buntzler, in a collection of 112 cases of dislocations of the shoulder, states that in 10 of these cases a paralysis limited to the deltoid was observed to follow; and in 7 a paralysis involving a greater number of muscles. The occurrence of deltoid atrophy and loss of function has, moreover, also been frequently observed after traumatism of the shoulder, such as blows, contusions, or falls upon the same. The rate of frequency of this affection after such lesions cannot, however, be definitely determined. In approximate terms it may be stated that, in order of frequency, this traumatic paralysis from these causes stands next to that which follows dislocations of the shoulder, if not numerically equalling it. As a third cause of deltoid atrophy is to be classed fractures of the humeral head.

Other causes which have been assigned to paralysis of the deltoid are pressure of the crutch (Gowers, Church, Goodno, etc.); a prolonged pressure over the area of the deltoid, as in miners who, in digging ore, lie for long periods on their left side (Seligmueller); and certain operative procedures of the axilla in which the circumflex nerve may be severed. Senguin, in certain instances later to be referred to, gives the prolonged abduction of the arms, as when folded over the head, as one of the causes of deltoid paralysis.

As non-traumatic causes this paralysis may supervene secondarily to an arthritis, periarthritis, myositis of the deltoid muscle, or after an inflammation of the subdeltoid-acrominal bursa from the involvement of the circumflex nerve in the inflammatory process. In rare instances (according to Herter) the nerve may be the seat of a spontaneous neuritis. The occurrence of paralysis of the deltoid, moreover, has also been frequently observed after rheumatism of the shoulder-joint; and, as stated by Seligmueller,

it has been observed after a luetic myositis of the deltoid, and in one instance after typhoid.

Concerning the pathology of this affection but little has been definitely stated, though various views have been advanced by different writers. When of traumatic origin, these may be summarily classified as follows:

1. Compression and contusion of the nerve.
2. Stretching or traction of the nerve.
3. Laceration and complete division of the nerve.
4. Neuritis of the nerve secondary to the traumatism.

The view once expressed by Malgaigne, that this paralysis, in common with all traumatic paralyses of the upper extremity, is the result of a "commotion nerveuse" can be briefly dismissed without further mention. Similarly, also, the view which has been advanced by Hamilton and others, that the paralysis is the direct result of the bruising of the muscular tissue or of a myositis of the muscle, and which, therefore, has no neural factor.

The most frequent cause of circumflex paralysis is, apparently, the contusion or compression of the nerve. In a brief anatomical consideration of the circumflex nerve as pertaining to its surgical affections, it may be readily divided, according to its various positions along its course, into three portions, viz., the cervical, axillary, and humeral. Of these the cervical portion lies in the subclavian triangle of the neck. In this part the fibres of the circumflex are still incorporated in the cervical nerves and in the cords constituting the brachial plexus.

The statements as to the number of cervical nerves from which it takes its origin are somewhat variable. According to some authorities the fifth, sixth, seventh, and eighth cervical nerves all contribute to its formation; while others give but the fifth, sixth, and seventh, or the fifth and sixth cervical nerves. The cervical portion of the circumflex nerve, which extends, therefore, from an inexact number of intervertebral foramina to the first rib, can not be singly involved in traumatic or other pathological lesions, for the reason of the intimate relationship of its fibres to those which give origin to other nerves of the upper extremity. Trau-

matic injuries in this portion, such as compression, lacerations, or neuritis from injuries, are essentially those of the cervico-brachial plexus, and in consequence involve a group of muscles and not single muscles, so that little is to be said of this portion of the nerve in the consideration of its isolated paralysis.

In the second or axillary portion, which extends approximately from the first rib to the quadrangular division of the subscapular triangle, the nerve is in part still incorporated in the posterior cord of the brachial plexus, and in part is found as a single individual nerve trunk, so that traumatic injuries of this part may involve the nerve and the structures it innervates singly. Posteriorly this portion of the nerve lies in relation to the subscapularis and the posterior axillary wall, while anteriorly the muscular mass of the pectoral muscle serves as a most efficient protection against injuries of an extrinsic nature. Internally and externally also the arm and thorax render trauma from without almost impossible.

The third—humeral or terminal—portion of the circumflex nerve extends from the before-mentioned quadrangular division of the subscapular triangle to its terminal nerve endings within the deltoid, teres minor, and integument. Characteristic of this portion is its spiral course, from which the nerve has received its English term of circumflex nerve. In its spiral course it embraces the surgical neck of the humerus, and is superficially usually denoted at a point two inches below the acromion. The humeral portion of the nerve is situated for the greatest part of its course in the interval between the deltoid and the bone lying in the loose areolar subdeltoid tissue and in a somewhat inconstant relation to the subdeltoid or subacromial bursa.

Compression or contusion of the nerve, without a like involvement of other nerve fibres, can occur only in its axillary or humeral portion. In the former it is a result of a luxation of the head of the humerus; in the latter the direct consequence of a blow or fall upon the shoulder. When resulting from a luxation of the head of the humerus the compression or contusion is effected against the posterior axillary wall, the subscapularis, and underlying scapula at a point shortly prior to the entrance of the nerve in the

quadrangular division of the subscapular triangle; or as Tillmann, in connection with paralysis of the circumflex, states, "Compression of the nerves and vessels of the axilla occurs especially when the head remains in the axilla in the vicinity of the lower border of the glenoid cavity."

The compression of the circumflex nerve as a result of shoulder dislocation is, however, usually accompanied by a stretching or traction of the nerve in its third portion, as the entire nerve by the displacement of the humeral head experiences an increased tension. In a specimen reported to be in the St. Bartholomew Hospital the circumflex nerve, as a result of shoulder dislocation, is stated to be flattened and compressed. In the view expressed by Nélaton that the anatomical disposition of this nerve was an extremely favorable factor for its distention and compression, the combination of these two lesions of the nerve in dislocations was probably already recognized.

The most typical example of pure compression of the circumflex nerve is to be found in its terminal portion when this injury is the result of a blow or a fall on the shoulder. While the thick muscular layer of the deltoid has been said to offer an efficient protection, and the occurrence of such injuries has therefore been stated to be improbable, and has also been altogether denied, clinical observations tend to verify the statement that paralysis of the circumflex is frequently the result of such lesions. The experiments of Weir Mitchell, in which the paralysis ensuing upon nerves being struck with a whalebone slip, a thin layer of muscular tissue intervening, was found to be temporary, although in degree complete, elicit no deduction on the subject in question. It can, however, most readily be assumed that even but a slight degree of compression of a nerve situated as the circumflex, against a bony surface, can be productive of this lesion, and that, while the thick muscular mass of the deltoid serves in many instances as a protective layer to the nerve, this is not the invariable rule.

The deleterious factor in such instances, moreover, is not always the compression or contusion itself, but a resulting neuritis, which, by extension and involvement of further fibres of the nerve, ulti-

mately renders this structure functionally inert. In numerous cases the injury is undoubtedly not to the main trunk of the nerve, but to its terminal intramuscular branches and endings within the deltoid, which may be definitely stated to be more readily affected by the trauma. In such instances, again, a neuritis may supervene, and the whole nerve then be ultimately involved.

The effects of contusion or compression of the nerve are frequently aggravated by the resulting extravasations and inflammatory exudates. Œdema consequent to the injury is constant, while hemorrhagic extravasations are also frequent. Both of these may be either extra- or intraneural, or be combined. When extraneural, these extravasations may reach immense proportions before such an effect as compression is produced, as the nerve throughout its course is surrounded by loose areolar tissue. Intraneural extravasations are much more prone to exert a deleterious influence. In a purely serous infiltration of the nerve a complete paralysis of the nerve is probably not frequently evidenced, and with the absorption of the exudate, moreover, the symptoms of paralysis simultaneously disappear. In the so-termed "apoplexy of the nerve," however, serious consequences are apt to follow, and secondary degenerative changes of the nerve are also more prone to supervene, and, similarly, a neuritis. The paralysis in such instances becomes evident for longer or shorter periods, and may be permanent.

Another cause of compression of the nerve, post-traumatic in origin, is the formation of an undue amount of cicatricial tissue, or fibrous bands, or adhesions. An instance of the latter class is reported in the case of Hilton, who examined the body of a man who had died thirteen weeks after having received a dislocation of the shoulder into the axilla. The deltoid was much atrophied; the circumflex nerve was small and was "distinctly lacerated, but its actual condition was changed by some strong cellular adhesions fixing it with the radiospiral nerve and the axillary artery to the inner surface of the subscapularis muscle."

The supervention of a periarthritis after dislocations of the shoulder, or of a peribursitis after inflammations of the subdeltoid

bursa, especially in aged individuals in whom a tendency to neurofibrosis exists, is also apt to lead to a weakening of the function of the deltoid or to the actual complete paralysis of the same from the pressure exerted upon the circumflex nerve or its branches by the surrounding fibrous tissue.

Traumatic isolated paralysis of the deltoid from stretching or of traction on the nerve may occur either in its axillary or humeral portion. In the cervical portion these lesions, when occurring, do not involve the fibres of the circumflex nerve singly. It is, however, to be noted that that portion of the brachial plexus and the cervical nerves from which it takes origin, as Victor Horsley states, are readily injured in this manner. In a dissertation on the traumatic neuralgia of the brachial plexus, he writes concerning the same that "There is one part of the body in which stretching of a nerve is not uncommon, and that is in the posterior triangle of the neck. It occurs when the head is forced violently in one direction and the shoulder in the opposite direction; for instance, when the person is thrown out of a wagon the stretching force is exerted along the line of the fifth cervical nerve, the first dorsal at the lower part of the plexus escaping injury. The fifth cervical nerve would be stretched, but the first dorsal nerve would be slackened. It is the fifth cervical nerve, and to a less extent the sixth, which suffer; and the paralysis is limited to the preaxial border of the limb and to Erb's group of muscles—*i. e.*, to the deltoid, biceps, and supinator longus." As seen, therefore, the line of greatest traction is along the cervical nerves and brachial cords in which the circumflex nerve is incorporated. The paralysis resulting from such traction is, however, not limited to the circumflex nerve alone, but involves a group of muscles simultaneously.

In the axillary portion of this nerve traction is exerted in the instances of shoulder dislocation by the head of the humerus. But this injury is probably always accompanied by a contusion or a compression more or less severe in degree. As already stated, the traction force in such instances is most evident in the humeral portion of the nerve, although also present in the axillary portion.

Relative to the traction or stretching of the circumflex nerve, Raymond has lately reported certain instances in which this occurrence is stated to be the result of an abnormal anatomical disposition of the nerve. He reports the case of a male, aged twenty-three years, who fell asleep with both of his hands placed behind his head. On the following day he experienced an inability to raise his arms, as well as a paræsthesia. The examination revealed an isolated paralysis of both deltoids, all other muscles being functionally in good, active condition. There was a partial degenerative reaction of the deltoid, a slight atrophy of the same, and a diminution in the sensibility in the area of the circumflex nerve.

The atrophy of the deltoids, as resulting from the extreme abduction of the arm, is explained by an elongation of the nerve, the elongation being due to an abnormal course of the nerve. Dissection of the cadaver, performed for this purpose, has revealed the fact that, in exceptional instances, the circumflex nerve does not wind around the humerus, but pursues a straight course from its origin to its termination. Raymond assumes that in the case reported this anomaly of the nerve was present, whereby the traction on or the elongation of the nerve could readily be explained.

Laceration or complete division of the nerve may be either caused by a luxation of the shoulder or a fall upon the same. In the former the partial or complete loss of nerve continuity affects the axillary portion, and is the result of the severe traction exerted upon it by the humeral head. In such injuries as blows or falls upon the shoulder the laceration or complete division of the nerve is the result of the violent compression.

Symptomatology. As a result of circumflex nerve injury we have a deltoid paralysis, which renders the patient unable to lift the arm from the side. The deltoid gradually atrophies. The contour of the shoulder changes so as to assume a flattened appearance, and the round head of the humerus becomes easily distinguished, and, as contrasted with the other shoulder, particularly if the patient be fleshy, the appearance is not at first glance unlike that of a dislocation of the shoulder-joint. In extreme cases the

great relaxation and thinning of the deltoid make it possible to feel the groove between the neck of the scapula and the head of the humerus, and it has very frequently occurred that this deformity has been incorrectly diagnosed or interpreted as an unreduced dislocation of the head of the humerus.

At other times, in addition to the muscular paralysis and atrophy, there occurs an arthritis which results in ankylosis of the joint, and prevents the restoration of any considerable degree of function in the joint by a compensatory development of other muscles. This arthritis has been by some regarded as a result of the nerve injury; but when one considers the severe nature of the associated injury and the fact that a large percentage occurs among laboring men, who often have a chronic synovitis, and the considerable number who give a rheumatic history, I am inclined to believe that it is very seldom due alone to the nerve injury.

Paralysis of the teres minor could scarcely be made out unless the supraspinatus is also impaired in its function. It has been commonly stated that the deltoid raises the arm to an angle of ninety degrees, and that from that point the serratus magnus raises it another ninety degrees, or to the vertical position.

Duchenne (in 1867) deduced on an electro-physiological basis that the most powerful action of the deltoid lies in the anterior or clavicular fibres, these alone being able to lift the arm through an angle of 90°. The power of action is then stated to decrease in a posterior direction. The posterior portion—that arising from the scapular spine—is only capable of elevating the arm to an angle of forty-five degrees.

Duchenne further states that in a powerful contraction of the entire muscle the arm may be raised above the usual stated limitation of the horizontal. While this limitation in the action of the deltoid to the horizontal has been held by the great majority of observers to be definite, more recent observations contradict this view.

Steinhausen, among others, emphatically denies the equal proportion of the quadrants of the deltoid and serratus magnus, claiming that the normal action of the deltoid is through an arc of one hundred and twenty degrees instead of ninety degrees.

Trophic changes in the shoulder-joint, which is also supplied by the circumflex nerve, are seemingly of rare occurrence. Church states that the nutrition of the joint suffers, and that arthritis is likely to develop. No complications of this nature have, however, been reported.

Of the tegumentary changes the skin has been described as appearing stretched in some cases, probably from the lengthening of the arm; and as loose in others, from the atrophy of the underlying muscular bed. Anæsthesia over the deltoid area is not infrequent, although not constant. Church limits the occurrence of this anæsthesia to the lower two-thirds of the deltoid area, but in general it can be said not to be well defined.

The degree of the anæsthesia when present is variable, varying from a complete loss of sensation to no loss at all. More distinct sensory disturbances have occasionally been observed, as in the case of Egger, who refers to the absence of the sense of touch, a diminution in the sense of pain, and of the perception of the faradic current. During the application of the cathodes to the integument with a fairly strong current a very noticeable yellowish-white discoloration of the integument, with a distinct lowering of the temperature in the same area, was noted. After such continued irritation a spotted red color appeared in the areas, which were first to turn white; and from the periphery red protuberances radiated inward, till finally the red was evenly distributed. This peculiar reaction of coloration in the integument is said to be the consequence of the paralysis of the vasodilator fibres of the circumflex.

Prognosis. In general terms the prognosis is not good, a very considerable number of cases not only losing the use of the deltoid, but become either ankylosed or fail to develop the synergistic muscles sufficiently to relieve the patient of a very great disability.

We must, however, remember that the dependence of the arm upon the deltoid for its elevation is not total. A synergistic action of other muscles normally exists, which, in a functional disability of the deltoid, can assume a compensatory action. A vicarious

action of different muscles normally not synergistic to the deltoid is, moreover, known to occur.

Duchenne (in 1867) reported an instance of rheumatic arthritis of the shoulder-joint in which the deltoid, as determined by its electrical reaction, was totally absent. The arm, however, could be elevated to the vertical in an oblique anterior and external direction, the humerus during this movement rotating around its axis in an upward direction. The supraspinatus, with the serratus magnus and the middle part of the trapezius, are stated to have assumed the compensatory action of the absent deltoid. One of the most typical instances of this kind, and well illustrative of this occurrence, is the case more recently reported by Kennedy in which a paralysis of the deltoid supervened after a dislocation of the right shoulder-joint. This man was unable to raise his arm for six months. An improvement in the elevation of the arm, however, gradually appeared, so that (two and one-half years after) his range of movement and power in that joint was such that only careful inspection could detect any abnormality. The compensatory action of the deltoid, which was totally absent in this case, had been assumed by the supraspinatus and rotators of the scapula, such as the trapezius. Similar cases have been reported by Hoffman, Brothers, Kron, and Lowe.

The muscles which are said to have assumed such function in these cases are the supraspinatus, serratus magnus, trapezius, pectoralis major, and coracobrachialis. Duchenne, as well as Kennedy, attributes the power of elevation of the arm in their cases to the true joint action of the supraspinatus, trapezius, and serratus magnus. In the cases of Lowe prominence is given to the supraspinatus and trapezius alone, with preponderance to the former muscle. Hoffman, in a case of this kind, attributes the compensatory action in the elevation of the arm to the pectoralis major, and Kron in two cases regards the upper portion of this muscle as the direct elevator of the arm in the absence of the deltoid action.

Of these muscles the supraspinatus, either singly or conjointly with other muscles, has most frequently assumed the deltoid func-

tion. In its anatomical disposition, its origin, insertion, and course it resembles to some extent the deltoid, so that, from a purely dynamical consideration, it can most logically be regarded as being the most capable of supplanting this muscle and to act as a second deltoid. Duchenne stated that the action of this muscle was an auxiliary one to the deltoid, and gave to it a distinct action of elevating the arm. Clinical observations, he states, have demonstrated that the supraspinatus is capable of elevating the arm to the same height as the deltoid. But it differs in its action from the latter in that its power is comparatively much less.

Lowe states that the supraspinatus is capable of assuming the entire function of the deltoid, and furthermore adds that the reason the arm can be elevated in certain cases of deltoid paralysis is that a variation in the course of this muscle probably exists. In such cases it is assumed to pass directly over the head of the humerus.

The reaction to the electrical currents, as in all nerve palsies, gives a fairly accurate conception of the changes going on in the structure involved; and if there be a complete loss of reaction of nerve and muscle to both currents the prognosis must be unfavorable, as they are almost invariably without hope of recovery. The loss of reaction to the interrupted current and increased reaction to the continued current indicates the severity of the case, though there is still a hope after months of treatment of improvement, though rarely of complete recovery. A normal or slightly diminished reaction to both currents makes the prognosis a favorable one.

While paralysis of the circumflex in connection with injuries to and paralysis of other nerves about the shoulder-joint is a very common occurrence in the experience of many physicians, yet the reported cases of isolated injury to the circumflex are relatively few. I have collected a limited number, which may fairly be classed as such an injury, and have tabulated them as follows:

ISOLATED CASES OF CIRCUMFLEX PARALYSIS.

No. of case and name of observer.	Sex and age.	Occupation	Nature of accident.	Paralysis noticed.	Time after injury of last observation.	Result.
1 Kron	M. 19	Laborer	Wagon wheel ran over right shoulder.	Immediately.	½ yr.	Arm raised to horizontal by deltoid; trapezius and pectoralis major hypertrophied.
2 Kron	F. 43	.....	Fell on right shoulder.	11 months.	.....	Can be raised to vertical, aut. fibres of deltoid, pect. major, coracobrachialis.
3 Lowe	M. 24	Laborer	Cement pipe fell on right shoulder.	Immediately.	6 mos.	Supraspinatus lifts arm to horizontal; reaction of deltoid entirely gone; functional motions almost perfect; power lessened
4 Lowe	M. 43	.....	Dislocation (left).	.....	2 yrs.	Shoulder-joint freely movable; trapezius and suprascapularis hypertrophied; deltoid atrophied completely.
5 Lowe	M.	.....	Dislocation (left).	More than a year.	.....	Motion free; elevation good; deltoid absent.
6 Hofmann	M. 21	Soldier	Spear wound of neck.	Immediately.	.....	Muscle eventually restored to its function.
7 Leute	M.	Boatman	Dislocation.	Short time.	11 wks.	Complete atrophy of deltoid; no compensation.
8 Leute	M.	Laborer	Injured his shoulder.	Immediately.	Several weeks.	Lost use of arm.
9 Barling	M.	.....	Injured his shoulder.	.....	.....	Loss of power and atrophy of deltoid.
10 Tiffany	M. 33	Sailor	Dislocated shoulder by extension.	Immediately.	4 mos.	Paralysis of deltoid greatly improved; resembles partial dislocation.
11 Tiffany	M.	.....	Fell striking left shoulder on ground.	.....	3 mos.	Complete paralysis of deltoid; no cutaneous anæsthesia.
12 Cunsard	M. 47	.....	Fell from height, dislocating right shoulder.	After reduction.	.....	Complete paralysis.
13 Raymond	M. 23	Mail carrier	Slept with hands behind his head.	Next day.	.....	Isolated paralysis of both deltoids.
14 Egger	M. 66	.....	Dislocation.	After reduction.	2 mos.	Atrophy of deltoid and complete degenerative reaction.
15 Block	F. 46	.....	Pressure of glandular metastasis from breast cancer.	.....	8 mos.	Paralysis of deltoid and probably teres minor.
16 Kennedy	M.	.....	Dislocation of right shoulder and fracture of radius.	After removal of splints.	.....	Deltoid totally paralyzed, but functional recovery almost perfect; atrophy of deltoid and teres minor.
17 Pooley	M. 30	.....	Fell from high stoop.	Following day.	8 wks.	No recovery of deltoid function.
18 Althrop	 18	.....	No history.	Noticed when patient was three years old.	15 yrs.	Complete atrophy of deltoid (right).
19 Hilton	M.	.....	Dislocation into axilla.	.....	At autopsy, 13 wks. after accident.	Deltoid much atrophied; circumflex nerve very small and distinctly lacerated.

It will be noted from this table that eight, or nearly 50 per cent., of the cases followed dislocation, seven cases resulted simply from a contusion, one from a wound in the neck, one from stretching, one from pressure of enlarged gland in axilla.

It is of interest to note the time at which the paralysis was first noted. In most cases it was reported as having been observed immediately after the injury or after the reduction of a dislocation, though in one case eleven months had elapsed. In my own experience it has almost uniformly been observed after splints or dressings had been removed, or in from two to eight weeks. If possible, it would be a distinct advantage to examine for this injury immediately after receipt of injury or reduction of dislocation, not that any appreciable benefit would be likely to accrue to the patient, but because it would aid us very greatly in making a more serious prognosis in an injury of apparently insignificant extent.

While the number of cases tabulated is very small, yet it is interesting to note from a prognostic standpoint the final result. In Cases I., II., III., IV., V., VI., and XVI.—or about 37 per cent.—there was functional restoration of the joint. In Cases VII., VIII., IX., XI., XII., XIII., XIV., XV., XVII., XVIII., and XIX.—or 58 per cent.—no improvement in the use of the arm is recorded; while in Case X. the paralysis was greatly improved, but evidently considerable atrophy remained. Notwithstanding the fact of the functional recovery of Cases I., II., III., IV., V., VI., and XVI., it is to be noted that in Cases III., IV., V., and XVI. the deltoid remained completely paralyzed and atrophied, thus demonstrating that a favorable outcome may be expected as a result of compensatory or vicarious action of other muscles previously referred to.

2. Isolated Paralysis of the Long Thoracic Nerve. The posterior or long thoracic nerve derives its origin from the fifth and sixth, or fifth, sixth, and seventh cervical nerves, and is divided into a cervical portion, which extends from its origin to the end of the first rib, and for a part of its course is placed in the substance of the scalenus medius muscle, afer leaving which it is joined to the root of the seventh cervical, and passes posterior to the axillary vessels and the brachial plexus. The second portion extends

downward from the first rib upon the serratus magnus muscle lying between this muscle and the subscapularis.

Isolated paralysis of the serratus magnus, unlike that of the deltoid, was known quite fully to the earlier writers. Berger (in 1873) and, a year after, Lewinski both wrote in detail regarding this affection. The latter, in a complete review of the cases reported up to that time, denies the frequent existence of isolated paralysis of the serratus magnus, which was then generally assumed, stating that the meagre reports of many of these cases do not admit of their being classed in this category. Since then, however, numerous cases have been reported in full, which definitely establish the fact that isolated paralysis of the serratus magnus is both frequent and probably much more common than is generally assumed.

As the etiological causes of serratus paralysis there are given rheumatic affections, exposure to draughts, sleeping on damp ground, the infectious diseases (in many instances it being stated to have appeared after typhoid or influenza, and, according to Seligmueller, it has been observed in one case after diphtheria); excessive muscular strain from the prolonged and excessive use of this muscle, as in mowing, carrying a heavy child, planing, using a heavy hammer, continued elevation of the arms in the vertical position, as in painting a ceiling, hanging on crossbars, as also the so-called "strains" from "overlifting," the carrying of heavy weights, blows and falls on the shoulder and back, hyperextension of the arm, and punctured and gunshot wounds have also been variously given as the causes of this affection. Paralysis of the serratus has, according to Mann, also resulted from suppuration of the cervical glands; and according to others, as Kohler and Frohse, it has in certain instances been the sequel to the extirpations of supraclavicular glands and tumors from the section of the nerve. In the dissection of the axilla this operative injury to the nerve is also probable. It is also one of the first muscles affected in progressive muscular atrophy.

Isolated paralysis of the serratus is generally stated to be much more frequent in men than in women; according to Berger it is

eight times as common in the former, and, according to Gowers, nine times. It occurs most frequently in laborers and muscular individuals during the active period of life—that is, from twenty-five to forty years—for the reason that during this time exposure to injuries and atmospheric alterations is greatest. It is much more frequent on the right side than on the left, and in the majority of instances is unilateral. When of traumatic origin it may occasionally be bilateral; but in such cases the nerves of the two sides are not injured simultaneously, but at successive times.

Gowers speaks of a man who became affected with a serratus paralysis of the right side from carrying heavy beams on the shoulder; he then carried them on the opposite shoulder, so that the left serratus also became paralyzed.

The paralysis of the serratus magnus entails an injury to the long or posterior thoracic nerve. In the consideration of those instances in which this nerve alone is paralyzed as a result of traumatism, these may be classified as due to:

1. Prolonged pressure of the nerve, as by the carrying of heavy weights upon the shoulder.

2. Pressure due to contraction of the scaleni.

3. Blows or falls which cause a contusion or laceration of the nerve.

Paralysis from prolonged pressure, as from the carrying of heavy weights, can only occur in the cervical portion, since in that portion we may have compression of its roots and of the entire nerve trunk against the transverse processes of the cervical vertebræ. The same effect may be produced by sudden blows upon the inferior lateral cervical region.

Compression of the nerve in the cervical region may occur as the result of excessive or violent contractions of the scalenus medius upon the portion of the nerve lying within its substance. In this connection Mann has called attention to the effect of hyperextension of the neck, as in an endeavor to reach a high object with the arms, thus rendering the scaleni muscles very tense; and when these movements are continued the nerve may be so injured that molecular changes result, which tend to interfere with its

conductivity. Gowers refers to a case in which one of the probable causes of the serratus paralysis following parturition was thought to have been violent muscular contractions; and Erb also states that one of the most probable etiological factors is a repeated muscular compression of the nerve.

In one of my own cases this etiological factor seems to be clearly demonstrable; the paralysis was caused by repeated violent jerking motions made by a switchman in an effort to lift a frozen lever to throw the switch.

The cases of paralysis subsequent to the violent exercise of swinging a hammer, the continued elevation of the hands above the head, etc., are all to be classed under this head, since the scalenus medius is rendered more or less tense for considerable periods.

Naturally, injury to the axillary portion is less frequent, as its position between the serratus and the subscapularis serves is an efficient protection. Severe blows upon the back and side of the thorax may, however, injure the nerve by hemorrhagic extravasation—possibly either extraneural or intraneural—causing degeneration or traumatic neuritis.

In one of the writer's cases the paralysis appeared to be due to an injury to the axillary or thoracic portion, associated with fractured ribs. Paralysis of this portion of the nerve may also follow its injury during operations upon the breast and axillary glands.

Symptomatology. The symptoms of serratus paralysis as generally stated are the inability to elevate the arm beyond a right angle and an undue prominence of the vertebral border of the scapula. The treatise of Berger in 1873, based on a collection of all cases up to that time, recognizes the inability to elevate the arm through the upper quadrant as the most important symptom. This statement, which is still almost general, was then, as now, dependent on the dogmatic assertions concerning the action of the serratus magnus. The action of this muscle, according to this statement, is that of elevating the arm from the horizontal to the vertical by means of the rotation of the scapula. In the paralysis of the serratus it is then generally assumed that this movement

is lost. Clinical observations and more accurate anatomical considerations as to the true action of the serratus have demonstrated the fallacy of both of these views.

The position of the scapula, both with the arm at rest at the side and when elevated, forms a characteristic symptom of serratus magnus paralysis. It varies from the normal in this: that the vertebral border assumes an oblique instead of a parallel direction with the spine; and there occurs a very striking projection of this border, most noticeable at its inferior angle, from whence it derived its name of winged scapula. The obliquity is from above downward and inward. While by a great number of clinical observers it has been stated to be a pathognomonic sign of isolated serratus paralysis, according to others it is said not to be invariably present. Berger, in his monograph, classified this symptom both as the most important and the most characteristic. Lewinski, on the other hand, attempted to refute its importance in stating that, with the arm in the resting position, no such deviation is perceptible to inspection. However, with the arm elevated in a forward and lateral direction, this deviation occurs in a very perceptible degree.

Subsequently to this such clinical observers as Seligmueller, Eulenburg, Bruns, Placzek, Gowers, Strümpell, Oppenheim, Morstadt, Brodmann, and others corroborated the importance of this symptom, while Brenhardt and Mann, on the other hand, opposed it. Eulenburg and Seligmueller state that it is pathognomonic of serratus paralysis.

It appears from a closer analysis of the various opinions expressed, as well as from the reports of the cases observed, that the deviation of the scapula with the direction of the vertebral border referred to can be stated to be one of the most, if not the most, typical symptom of serratus paralysis. This deviation of the scapula is to be attributed to the unopposed action of the trapezius, levator angula scapula, as well as the rhomboids. In a simultaneous paralysis of either of these muscles the deviation of the scapula is said not to occur, which fact offers the explanation for those instances in which the position of the scapula remained unaltered.

Duchenne was probably the first to deny the occurrence of a deviation of the scapula in paralysis of the serratus. He, however, states that he had never observed an isolated paralysis of this muscle, there being always associated with it a paralysis of the trapezius, and especially of its lower portion. The degree of the variation of the scapula is variable, being readily made out in some cases, while in others it is not so perceptible. It is dependent on the developmental or functional ability of the rhomboids, trapezius, and levator angulæ scapulæ, all of which tend to pull the scapula inward.

Anatomical and physiological variations in these muscles explain to a large degree the variation in the degree of deviation. Among other symptoms whose pathognomonic values have not been denied are to be mentioned the high position of the scapula on the affected side, its approximation to the vertebral column, and the protrusion of the vertebral border, especially of its inferior angle. In one of the writer's cases the protrusion amounts to two inches.

These three symptoms are definitely constant. The elevation or high position of the scapula results from the unopposed action of the superior and middle portions of the trapezius, together with the auxiliary action of the levator angulæ scapulæ. The abduction toward the vertebral column is also to be attributed to these muscles, together with the rhomboids. This abduction becomes more evident the further the arm is raised from the trunk and the nearer it approaches the horizontal.

In a case of Ferrier's it is stated that, with the arm extended at a right angle, the vertebral border of the scapula overlapped the spines of the vertebræ. In instances in which both serrati are paralyzed these two borders of the scapula may touch each other when the arms are elevated, as in the cases reported by Sperling, in which the two bones in this manner form a perfect hollow passage with the thorax. In two cases reported by Hecker the posterior border of one scapula overlapped that of the other; and in an instance reported by Cejkathe the inferior angles of the scapulas audibly struck against each other. In this approximation of the scapula to the vertebral column there is not uncommonly

mentioned in the interval between these two bony structures a muscular prominence which increases with the degree of the abduction of the arm from the trunk.

The prominence of the vertebral border, or the winged scapula, forms, as stated, one of the ever-present symptoms of serratus paralysis. As noted, it is most evident at the inferior angle. This symptom explains itself directly from the inaction of the serratus, one of whose important functions consists in retaining the scapula in close contact with the thoracic walls, the greater portion of the serratus being inserted at the inferior angle. The effects of its paralysis and consequent protrusion manifest themselves most prominently at this point. Besides the relaxation of the serratus, the action of the pectoralis minor, which is inserted at the coracoid process, tends to lift the inferior angle of the scapula from the thoracic walls. This winged appearance of the scapula is most apparent with the arm more or less elevated, as the unopposed action of the scapular muscles is thereby increased.

The extent to which the serratus abducts the scapula to the thoracic walls is well demonstrated in the paralysis of this muscle. As a frequent symptom of this affection there has been noted an ability to push the fingers or hand under the venter of the scapula or between this bone and the thorax. The extent to which the scapula may thus be lifted from the thoracic walls is variable. Owen and Knott report a case in which the fingers could thus be pushed half-way up to the glenoid cavity.

Another symptom of serratus paralysis is the absence of the prominences caused by the digitations of these muscles. These are normally evident along the lateral aspect of the thorax below the axillary space, and are most prominent during the elevation of the arm. The absence of these digitations in the paralysis of the serratus is an indication of the atrophy of the muscle.

According to Berger, there results from this atrophy of the muscle a flattening of the lateral wall of the thorax on the affected side. A somewhat similar view was expressed prior to this by Strohmeyer, who wrote concerning serratus paralysis in the days in which the muscle was regarded as an important respiratory

muscle. Strohmeyer stated that the cause of habitual scoliosis was the unilateral paralysis of the serratus magnus, so that the ribs of the affected side were pulled inward by the diaphragm.

In bilateral paralysis, on the other hand, it is stated the thorax is flattened laterally, the ribs of both sides being pulled inward so that the thorax assumes the pigeon-breast shape.

This scoliosis of the vertebral column and the deformities of the thorax have been, when mentioned, emphatically denied by subsequent writers. Lately, however, Steinhausen reasserts that a static scoliosis is typical for total serratus paralysis, and explains the same by the altered position of the pectoral girdle from the permanent abduction of the scapula toward the vertebral column and the corresponding internal and posterior direction which the clavicle thereby assumes.

Of the deformities of the thorax as occurring from serratus paralysis an instance is given by Poole, who, in the report of a case, states that the effect of the paralysis on the shape of the thorax was remarkable, and was well shown by means of sections taken with a leaden cyrtometer at the midscapular level. With the arms at rest by the side the section appeared nearly bilaterally symmetrical; but when the serratus was put in action this symmetry disappeared, the left side bulging laterally owing to the upward pull of the ribs by the left serratus. The holding of the arms backward, moreover, caused a great recession of the sternal portion of the chest, due apparently to the backward thrust of the clavicles. With the arms in this position, by placing the hands on the side of the chest and asking the patient to inspire deeply, the diminution in the expansion of the right side was easily perceptible. The cyrtometer showed that during deep inspiration the want of symmetry between the two sides was very marked.

The sensory disturbances of serratus paralysis are of a most varied character. The affection most frequently begins with severe pains, which, however, in the great majority of instances, is rather to be referred to the injury than to any distinct alteration in either the serratus muscle or its nerve. The nature of the pain and its character are not definitely stated by most observers. Berger

says that generally this affection begins with severe tearing pains in the region of the shoulder, which radiate from this part into the arm and thorax. Paroxysms of pain are also said to occasionally occur. Other observers describe pain in the back at the insertion of the digitations of the muscle, and also in the neck and shoulder over the region of the brachial plexus. Other sensory disturbancss, such as anæsthesia, have not been noted, the long thoracic nerve being a purely motor nerve and containing no sensory fibres.

That the pain may be referred to different points is borne out by my own two cases, in one of which it occurred in the cervical region, while in the other it was very severe and confined to the axillary and thoracic portions.

Diagnosis. The diagnosis of isolated serratus paralysis is of easy determination. From the foregoing its most characteristic symptoms, briefly stated, are seen to be the oblique direction of the scapular vertebral border both in the resting position and in the elevation of the arm, together with its undue prominence, which is especially noticeable at the inferior angle. Other symptoms which tend to corroborate the diagnosis are the high position of the scapula and the inability to raise the arm above the horizontal. The latter symptom is not constant, and is somewhat unreliable, so that in its absence the diagnosis of serratus paralysis is by no means to be excluded. But few if any other affections present similar symptoms to serratus paralysis, so that the question of differentiation need scarcely be considered. According to Berger, rheumatism and contusions of the shoulder are to be taken into account. Both of these, however, should in a careful examination be definitely excluded. There remains, however, one affection—progressive muscular atrophy—in which the serratus magnus muscle is commonly one of the first muscles involved in the paralysis, and which, therefore, is to be excluded in the diagnosis of isolated serratus paralysis. This, if no other pathognomonic symptom of this affection exists, is made evident by successive examinations.

Prognosis. The prognosis of serratus paralysis is that shared by all isolated paralyses of muscles, and which has already been con-

sidered in the paralysis of the deltoid. The treatment also conforms with that of that affection, the cardinal factors of the same being massage, electricity, and gymnastics. It is to be noted that a vicarious action of other muscles often eliminates the disability which would otherwise follow the paralysis of the serratus magnus.

In the cases of Baumler, Wehn, Poore, Ross, etc., elevation above the horizontal and even to the vertical was obtained. Steinhausen (in 1900), in a collection of fifty-seven cases of isolated serratus paralysis, states that in 95 per cent. elevation beyond a right angle was found to be present. In a thorough consideration of the cases he concludes that this elevation beyond ninety degrees is not the exception, but rather the rule. The complete elevation to the vertical, or one hundred and eighty degrees, is, moreover, stated to occur twice as frequently as the elevation to a lesser number of degrees, but such cases are stated to be but partial paralysis, the upper serrations of the muscle still functioning.

The function of elevating the arm to the vertical is largely dependent on the serratus, but other scapular muscles are also concerned in this movement. In the consideration of isolated circumflex paralysis it was noted that the rotation of the scapula begins simultaneously with the action of the deltoid, and that, moreover, the latter is not limited to ninety degrees, but usually extends to one hundred and twenty degrees. The function of elevating the arm to some extent beyond the right angle, therefore, devolves in part upon the deltoid, and the degree to which this vicarious action may be developed has been noted in one instance in which the deltoid and serratus ultimately interchanged their actions.

Next to the serratus the middle portion of the trapezius acts most powerfully in rotating the scapula. Other muscles which assist in this rotation of the scapula are the supraspinatus and infraspinatus, the rhomboids, and levator angulæ scapulæ. It is to be noted that the middle part of the trapezius most frequently assumes the compensatory action of the paralyzed serratus, as reported in cases by Oppenheim, Bruns, Placzek, etc. Other portions of

this muscle are, however, not infrequently involved in this compensatory or vicarious action. Baumler, Eulenburg, Leube, and others report the middle and superior portions of the trapezius as being involved in this manner, while Bernhardt reports the middle and inferior portion of this muscle as being thus affected.

Of other muscles which are stated to have assumed the vicarious action, Bruns reports another case, in which the middle portion of the trapezius, the deltoid, the supraspinatus, and probably also the infraspinatus and posterior deltoid, besides the middle and upper portions of the deltoid, subserved this same purpose. Owens reports an instance in which the levator angulæ scapulæ, supraspinatus, and deltoid assumed the vicarious action.

It is evident from these and other reports that compensatory or vicarious action in serratus paralysis is not confined to any separate muscle or distinct group of muscles. The trapezius, however, plays the most important rôle, being affected in the great majority if not in all instances. Of the remaining muscles it may be stated with Steinhausen that the rotators of the scapula and abductors of the arm are physiologically one muscle. Their action cannot, therefore, be considered as a separate function, as they are intimately associated with that of the neighboring muscles, so that in the failure of one muscle to functionate, compensation and vicarious action readily follow. Why in certain instances a failure in compensation or vicarious action, and the failure to raise the arm from the horizontal to the vertical should occur, cannot be definitely stated. Variations of an anatomical and physiological nature of these muscular structures may, however, as in deltoid paralysis, be held to account for a majority of such instances.

Characteristic of serratus paralysis is the position of the scapula both with the arm in the resting position at the side and when elevated. This position of the scapula varies from that of the normal in that the vertebral border assumes an oblique instead of a parallel direction. There occurs at the same time a projection of this border which is most pronounced at its inferior angle, and in which the terms of scapula alata and winged scapula have found

their origin. The oblique position of the vertebral border is in a direction from above downward and inward.

As an index of what might be expected in a certain series of cases, I have tabulated a small number which I have succeeded in collecting, as follows:

No. of case and name of observer.	Sex and age.	Occupation	Cause of injury.	When first noticed.	Result.
1 Owen and Knott	F. 31	.....	Use of muscle in massaging (right).	....	Recovery under faradization.
2 Owen and Knott	M. 11	.....	Skipping rope (both sides).	2 months.	Recovery under faradization.
3 Poore	M. 48	.....	Unloading lumber (right side).	4 months.	Very slight reaction to electrical stimulation.
4 Bernhardt	F. 39	Midwife	Exposure to cold draughts (right).	6–8 weeks.	Could not raise beyond horizontal; electrical reaction normal
5 Bernhardt	M. 22	Butcher	Carrying weight on left shoulder.	Gradual.	Could raise only to horizontal.
6 Ferrier	M. 42	.....	Struck by pile of rice bags (right).	Some time after.	Only raise to horizontal; electrical reaction of degeneration.
7 Mann	37 M.	Laborer	Carrying heavy castings on right shoulder.	Several days.	Reaction of degeneration, followed by almost immediate recovery.
8 Sperling	M.	.....	Struck on left shoulder and fell on right.	Immediately.	Raise to horizontal when forearm extended; nearly to vertical when flexed.
9 Sperling	M.	.....	Not known; came on suddenly.	Following day.	Much improved.
10 L. Bruns	M.	.....	Not stated.	Suddenly.	Serratus remained paralyzed.
11 Brodman	M. 35	Laborer	Right shoulder pulled forward; neck extended; hyperextension of scaleni.	Immediately; caused some pain.	Serratus paralyzed; compensation good by trapezius, deltoid, and supraspinatus.
12 Steinhausen	M.	Soldier	Pulled by a horse, arm in vertical position (left).	4 weeks.	Serratus remained paralyzed; left thorax flattened; could elevate to 150 in oblique anterior plane.
13 Steinhausen	M. 22	Soldier	Carrying a heavy knapsack.	Gradual.	Flattening of left thorax; arm could be elevated best in oblique anterior plane; trapezius and deltoid hypertrophied; serratus not palpable.
14 Personal	M.	Laborer	Contusion of right shoulder and thorax; fractured ribs.	Several weeks; pain from beginning.	Great atrophy of serratus; loss of power to elevate above horizontal.
15 J.H.Lowman	M.	Laborer	Probable strain of scaleni, both sides.	Gradual.	Cannot raise above horizontal except with hands clasped in front.
16 Personal	M. 26	Brakeman	Jerking at switch which was frozen; probable strain of scaleni (right).	8 weeks.	Could only raise to horizontal.

It may be noted that in eight (or 50 per cent.) of these cases the paralysis was either completely recovered from or the vicarious

action of other muscles was so great as to make the loss of function comparatively insignificant. I may add, too, that much help may be derived from the use of a suitable support tending to fix the scapula to the thorax. Case XVI.—a brakeman—is about to return to his work, which necessitates climbing up on cars and constant elevation of his arm above the horizontal, being able to do this since the application of the support referred to.

3. Isolated Cases of Paralysis of the Suprascapular Nerve. The number of cases of this paralysis which have thus far been reported is very limited, and I believe they have never before been grouped together, so that I shall quote each of them in brief.

Case I. — Bernhardt (*Neurol. Centralbl.*, 1889, 214) reports the instance of a male, aged forty-eight years, who fell from a height of one metre. He attempted to break the fall with his extended right arm, so that he sustained a severe contusion of the right shoulder-joint. At the examination, some time after this, the member still pained both during active and passive motion, and a grating in the joint was also to be felt. Ventrally the right and left arm could be raised to the vertical in both the sagittal and frontal planes. There was a very evident depression in the right supraspinous fossa and a marked deepening of the infraspinous fossa. Rotation of the arm outward could be accomplished by the vicarious action of the deltoid and teres minor.

Case II.—Bernhardt (*Berl. klin. Wochenschr.*, 1894, 2). An isolated paralysis of the right suprascapular nerve was noted as the result of a neuritis, the cause of which is not given. The man appeared in the hospital, complaining of pain in the right shoulder. Some time after, during the same month, the pain had moderated, but increased during motion at the shoulder and beneath the acromion. There was also some difficulty in the elevation of the right arm. Inspection from behind showed that the right scapula lay somewhat lower down than the left, and its inner border, which was vertically directed, measured one-half to one centimetre farther distant from the vertebral column than the corresponding border of the left side. Toward the acromial end—

in the supraspinous fossa, as compared to the left side—a shallower area was to be observed. The infraspinous region was much deepened; the infraspinous muscle seemed to be totally absent. The rhomboid, levator anguli scapulæ, trapezius, and serratus magnus were healthy and functionated normally, and had good electrical reactions. The arm could be raised to the horizontal with perfect ease by the deltoid. With further efforts it could be raised to the vertical both in the frontal and sagittal planes; but the exertion of the deltoid and the upper portion of the trapezius became very evident during this movement. It appeared that these muscles endeavored to aid the arm to overcome the obstacle, and a distinctly palpable jerk gave the indication of the successful attempt, after which the arm continued its elevation to the vertical with ease.

The explanation of this condition was that the arm hung too low, as if subluxated downward, in consequence of the paralysis and atrophy of the supraspinatus—"the active suspensory ligament of the arm." (Duchenne.) At the beginning of the elevation of the arm the head of the humerus was placed still more on the inferior border of the glenoid cavity, and even slightly below it, so that it required a special exertion on the part of the deltoid, which was no longer functionally assisted by the supraspinatus, to raise it over this border. With a jerk it finally sprang into the cavity in the position it should have occupied in the beginning. External rotation of the arm was hindered, if not impossible. Writing remained uninfluenced, but in sewing the needle was always pointed externally. The arm could be well directed posteriorly, and all the other muscles of the upper extremity were unaffected. The electrical stimulation—both direct and indirect—of the infraspinatus was lost.

Case III.—Sperling (*Neurol. Centralbl.*, 1890, p. 290) reports the case of an old woman, aged fifty years, in whom the etiology of the paralysis could not be definitely determined. A pain suddenly appeared in the left shoulder, which during the following night spread to the arm and elbow. On the following morning the entire arm was paralyzed, the pain persisting. After

eight days the movements of the arm gradually reappeared. Three weeks after the arm could again be elevated. This elevation, however, did not occur vertically to the trunk, but the arm, after a rotation in the external direction, was elevated in a backward direction. From the latter position a total elevation was possible after gradually reaching the horizontal. The left hand could thereby be placed fairly well upon the back, but not upon the right shoulder, hardly reaching the right breast.

The movements of rotation, especially externally, could be accomplished; but those of elevation, anteriorly and antero-laterally, were executed with a great exertion. After five months of electrical treatment a marked improvement in the movements of the shoulder was noted. The placing of the left hand on the right shoulder was, however, still very much impaired. The infraspinatus muscle, as compared with that of the right side, was much flattened, while the supraspinatus, which had previously given an indication as to atrophy, was now in no way dissimilar from the muscle on the right side. The skin folds were thinner on the left side, the integument over the infraspinatus muscle being looser, and a pinching of the muscle was not possible to the same degree as on the right side.

Upon pressure with the finger a spot the size of a "zweimark-stuck," two centimetres distant from the spine of the scapula and its vertebral border, was found to be especially painful as well as hyperæsthetic. Among the sensory disturbances the diminution in sensation of the dorsum of the right hand is to be mentioned, which had appeared in the first week of the affection and had persisted since then.

The scapula of the left side was rotated around its internal angle, so that the internal border was directed obliquely from below externally in a superior and internal direction, it thus varying from the normal in that the shortest distance of the middle of the median border and the angle of the scapula from the spinous processes of the vertebræ was two and four centimetres to three and seven centimetres on the right side. The inferior angle was therefore approximated to the median line in contradistinction to

the view of Duchenne that, in total supraspinatus paralysis, this approximation of the scapula to the median line is so great that its median border is directed from below inward, upward, and outward.

Case IV.—Benzler (*Neurol. Centralbl.*, 1891, p. 251) mentions the case of a soldier who had overexerted himself, and who thereafter experienced a pain in the region of the shoulder, followed by a weakening of the right arm, which gradually increased in severity. On examination a depression of the infraspinous fossa was noted. Beneath the integument over this part only a thin layer of tissue was to be felt over the bone. The right scapula was a little farther distant from the vertebral column, and was also placed lower than the left. Raising of the right arm in the extended position was easily accomplished, but with less power than in the left; and similar flexion and extension of the wrist and the pressing of the hand were weaker on this side.

The patient was unable to bring the arm forward in the sagittal plane, and the arm passively raised to this position could not be held there. On placing the right hand on the left shoulder the arm flexed at the elbow was raised at first in the frontal direction to a horizontal plane, and then was drawn by the pectoralis over to the other shoulder. With the arm at the side internal and external rotation could be perfectly accomplished. The latter movement was, however, weaker than the corresponding movement of the left arm. The patient only complained of pain during the elevation of the arm to the opposite shoulder in the region of the acromion. About two centimetres from the spine of the scapula and from the median border of this bone a sensitive spot about the size of a "zweimarkstuck" was found. Electrical examination showed a partial degenerative reaction in the area of the suprascapular nerve. No fibrillary twitching.

Case V.—Goebel (*Deutsche med. Wochenschr.*, 1897, p. 298) reports a case of isolated suprascapular paralysis which was at first complicated with other paralysis. A carpenter fell from a height upon the ground, striking his right shoulder. After being unconscious for half an hour, he walked to his home. He had

sustained a contusion of his right hand and "a sprain of the shoulder," which necessitated his supporting the arm with the left hand, owing to the pain when it hung at the side. The entire region of the shoulder was swollen. All passive motions of the arm were painful, with the exception of a slight swinging of the arm in the anteroposterior direction. Abduction was actively impossible, and passively could not be accomplished owing to the pain.

In the diagnosis fracture and dislocation could be excluded, and a few days later, with the subsidence of the swelling, the existing symptom indicated a paralysis of the levator anguli scapulæ, rhomboideus, latissimus dorsi, teres minor, and clavicular portion of the deltoid. Ten weeks later there was found an emptiness in the fossa infraspinata, there being no muscular tissue overlying it, with the exception of the lower angle, which was covered by the latissimus dorsi. The fossa supraspinata also appeared somewhat flattened, especially in the region of the acromion, but this was not as apparent as over the infraspinous fossa. There was a feeling of looseness in the shoulder-joint. In the elevation of the arm as viewed posteriorly it was easily brought to the horizontal; then the motion ceased, the scapula being pulled somewhat inward and upward, in that the upper portion of the trapezius became strongly prominent; and after a more or less distinct jerk the elevation of this member continued uninterruptedly to the vertical. During the last phase of this movement the looseness of the joint was felt very distinctly by the patient.

Case VI.—Steinhausen (*Deut. med. Wochenschr.*, 1899, p. 360) reports the case of a young man, aged nineteen years, who in the gymnasium, while slowly lowering himself from the crossbars with flexed elbows, suddenly felt a jerk in the right shoulder. He continued his gymnastic exercises, but felt a gradually increasing pain in the posterior portion of the shoulder, which persisted for about three weeks, and which at times increased during the night, but was never severe enough to demand medical treatment. After this it decreased and disappeared permanently, but a gradually increasing weakness then appeared.

The examination showed the man to be a very muscular and well-nourished individual. Over the right shoulder a very distinct, almost triangular, depression over the infraspinous fossa was at once noticed. Immediately beneath the integument a flat bony surface could be palpated. The right supraspinous fossa, as compared with that of the left side, was also flattened, so that the spine of the scapula on the right side was very prominent, while on the left side it could not be seen. The trapezius on both sides was equally excitable to electricity. The right and left shoulders were of the same contour and same height, and the scapula had the same position on both sides. All the motions of the shoulder were unhindered, especially rotation of the arm; but the force of the latter on the left side, as well as that of forward and lateral elevation on this side, was diminished. The reaction of the left infraspinatus to direct and indirect electrical excitation was totally abolished, while those of the deltoid and teres minor were somewhat increased (vicarious action of these muscles). Disturbances of sensation were not present. Treatment: massage, douches, and galvanic current. After five months no improvement.

Case VII.—Hofmann (*Deutsch. med. Wochenschr.*, 1900, p. 260) reports the case of a male, aged twenty-two years, who fell from a wagon, striking his head, neck, and left shoulder, at the same time feeling something break in the region of the left acromion and upper part of the scapula. For three weeks after the accident he experienced severe pains during the elevation of the arm. At the end of this time he noted a certain weakness during the elevation of the arm, which gradually increased, so that he presented himself at the clinic.

The examination showed him to be a medium-sized man, of very powerful build and healthy appearance. There was no scar or callus from the injury. Viewed from in front no difference in the form of the shoulders was to be noted. From behind a marked flattening of the left shoulder was noticed. On the left side the infraspinatus was flattened, and but little of the muscle was to be felt. Above the spine of the scapula there was

no difference from the right side. The integument was everywhere unaltered, but over the left infraspinous fossa the sense of touch was decreased. The motions of the arms and shoulders on both sides were accomplished without any apparent disturbance, but the patient complained that in elevating the left arm and also during rotation a sense of weakness was to be felt.

When the elevation of the arm in the frontal and sagittal plane was opposed it was noted that these movements could be accomplished with less force on the left side. This became the more noticeable when external rotation was compared on the two sides in this manner. While on the right side the externally rotated arm was with difficulty turned inward when force was applied, on the left side this was easily accomplished. Pain and painful points were absent.

The electrical examination gave a complete degenerative reaction of the left atrophied infraspinatus. Through the nerve this muscle could not be excited by either the galvanic or faradic currents, and the direct excitation of this muscle was also lost to the strongest faradic current. All other muscles had a normal electrical reaction, that of the supraspinatus not being determined, as it was covered by the trapezius.

Suprascapular paralysis is a much rarer form of isolated paralysis than either circumflex or long thoracic paralysis. The first case occurring was described by Bernhardt in 1886. Since then, however, additional cases have been observed by the same writer in 1889 and 1894, while other observers have also encountered this affection—Hoffman (1888), Sperling and Benzler (1890), Goebel, Steinhausen, and Hofmann. In all this number does not exceed ten, so that the study of the symptomatology and clinical courses of this paralysis is limited to this small number of observations.

Etiology. The cause of suprascapular paralysis is either a traumatism or neuritis from other causes of this special nerve. In some of the instances thus far reported a fall from a height is given as a causative factor, while in other instances this fall is said to have occurred on the extended hand or directly upon the

shoulder. As other traumatic instances there are given the gradual lowering from crossbars (case of Steinhausen) and overexertion (case of Benzler). Gowers, moreover, states that isolated suprascapular paralysis may occur either alone or in conjunction with circumflex paralysis in dislocations of the humerus, as also by carrying heavy weights on the shoulder, while Church adduces a dislocation of the humerus as a cause of this paralysis. Tillmann states that the suprascapular nerve is most likely to be injured in connection with fractures of the scapula. Cases of this nature have, however, not as yet been reported, so that the assumption is seemingly based on purely theoretical grounds. Another cause which may produce this paralysis is a neuritis of whatever origin. The general allegation of "catching cold" is here also not wanting. On theoretical grounds the infectious diseases, typhoid, etc., may lead to such a sequel.

Most of the cases so far recorded have been observed in the male sex, occurring during the active periods of life in such vocations as laborers, soldiers, and athletes, in all of which the exposure to traumatism is great.

Pathology. As in isolated paralysis of the circumflex or long thoracic nerves, the pathological lesions which are associated with the paralysis are:

1. Contusion of the nerve.
2. Laceration of the nerve.
3. Complete loss of continuity of this nerve.

The most frequent and direct dynamical factor in the production of these lesions is usually stated to be the compression of the nerve between the surrounding bony structures, as between the clavicle and the transverse processes of the fifth and sixth cervical vertebræ or the first rib. Goebel, for instance, asserts that in his case the paralysis occurred from the compression of the clavicle against the vertebral column, whereby the suprascapular nerve was torn. Steinhausen also gives as the etiological factor compression of the nerve either between the clavicle and the first rib or the fifth and sixth cervical vertebræ.

The former of these views essentially agrees with the statements

of Gaup, Kron, and Budinger concerning narcosis paralysis of the upper extremities, as well as that of Sherwald in brachial paralysis, while the latter opinion is in accordance with the statement of Hoedmaker and Nom in Erb's paralysis. The fact that this nerve can be singly affected at this point without the involvement of other nerves is largely dependent upon its anatomical disposition. Arising from the upper cord of the brachial plexus, it is generally stated to contain fibres from the fifth and sixth, as also from the fourth cervical nerves. In this portion of the neck its size exceeds that of all other nerves, with the exception of the long thoracic nerve, which equals it. Directly after its origin it proceeds posteriorly and downward in a slightly oblique direction, or almost transversely, coursing beneath the trapezius, and is crossed by the omohyoid, soon after which it enters the suprascapular fossa and passes beneath the transverse ligament which bridges the suprascapular notch.

In the suprascapular fossa two or more branches are distributed to the supraspinatus muscle, the nerve then winding around the spine of the scapula and entering the infraspinous fossa, where it terminates by dividing into numerous divergent branches which supply the infraspinatus muscle. For the purpose of clinical study as pertaining to the isolated paralysis of this nerve it can most aptly be divided into its cervical portion, which extends from its origin to its scapular foramen and to the scapular or terminal portion, which extends from the latter point to its termination. Of the two portions in question the first is by far the more frequently, if not invariably, involved in cases of a traumatic nature, while a neuritis may involve either portion of the entire nerve.

In the scapular portion of the nerve, paralysis may be assumed to result from fractures of the scapula or from the compression of tumors, such as sarcomas, etc.

Symptoms. The symptoms of this isolated paralysis have been variously enumerated by the different observers. In the description of their cases by different writers an exact conformity as to the symptoms peculiar to this affection is not to be found. Among

these symptoms a defect in the external rotation of the arm has been reported in a number of cases, this deficiency being attributed to the palsy of the infraspinatus and, according to others, also of the supraspinatus. This impairment of external rotation is furthermore said to interfere with numerous movements, and, among others, with those which are executed during writing and sewing. The elevation of the arm in the sagittal and frontal planes is also stated to occur with less power, and another symptom depending on the loss of the muscular function is a looseness of the joint. A partial rotation of the scapula inward, as well as a variable degree of anæsthesia over the bone, have also occurred. The predominant symptom upon which all agree, but which only becomes evident in time, is the atrophy of the two muscles supplied by this nerve, causing shallowness or depression of the two fossæ, which is at once evident to inspection.

Upon a closer insight into the symptoms which have been enumerated, the functional alterations of the supraspinatus and infraspinatus muscles are seen to be usually limited to a weakness of the movements which are the result of their action. The supraspinatus is, as usually stated, the synergist to the deltoid, in that it aids in the elevation of the arm to the horizontal. Another action pre-eminently possessed by the supraspinatus is said to be the retaining of the head of the humerus in apposition with the glenoid cavity during the elevation of the arm by the deltoid. Simultaneously with this action it also tends to prevent the downward luxation of the humeral head during this movement, so that in brief this muscle seems to fix the head of the humerus in the glenoid cavity.

Duchenne, for this reason, applied to this muscle the term of "the active suspensory ligament of the arm." This action of the muscle, however, has been called into question. Steinhausen, citing Fick and Weber, states that it seems doubtful that this muscle should alone have this action, and that the long scapulo-humeral muscles, such as the biceps, triceps, and especially the deltoid, should not be credited with a similar action. In several of the cases of suprascapular paralysis it seems, however, that this

suspensory action is substantiated. In one of Bernhardt's it is stated that during the elevation of the arm a distinctly palpable jerk was noticed, after which the arm continued its elevation to the vertical with ease.

The explanation of this condition was that the arm hung too low, as if subluxated downward, in consequence of the paralysis and atrophy of the supraspinatus muscle.

In another case—that of Goebel—after a more or less strong jerk, the elevation of the arm continued uninterruptedly to the vertical. During the last stage of this movement a distinct looseness in the joint was felt by the patient. This writer states that the subjective looseness in the joint, and the corresponding jerking during the elevation of the arm is a symptom of suprascapular paralysis. The assumption of a suspensory action of the supraspinatus seems justified also in certain instances in which a flattening of the shoulder is said to have occurred, this being due to a partial displacement of the head of the humerus downward.

According to Gowers, in paralysis of this muscle the head of the humerus is less firmly fixed and the deltoid more readily fatigued; while, when both muscles are conjointly paralyzed, the head of the humerus is said to fall more than when the deltoid is paralyzed alone. In the majority of cases it is, however, to be noted that a disturbance of the fixity of the joint does not become evident.

From a purely anatomical consideration it appears that other muscles in relation to the joint could well guard against such an occurrence when the supraspinatus is either permanently or temporarily thrown out of action. Essentially the assumption of Steinhausen seems most logical and correct—namely, that the deltoid and other scapulohumeral muscles are able to prevent the preternatural looseness of the shoulder-joint, which has been ascribed to suprascapular paralysis. It seems also that, granting that a looseness of the joint should occur in the first stages of this paralysis, the vicarious action of the synergistic muscles would later most efficiently repair this faulty condition.

Of the functional alterations in the movements of the shoulder,

the impairment or total loss of external rotation have been mentioned as a distinct symptom, this resulting from the inaction of the infraspinatus, which constitutes the most powerful rotator of the arm. Duchenne gave to this muscle—it being the external rotator of the arm—an important place in the acts of writing and sewing. For this reason these acts should seemingly be much impaired, if not totally abolished.

In the cases of Bernhardt and Goebel this supposition seemed to be verified, but the later reports rather tend to disprove this assertion. While the assumption of Duchenne concerning the acts of writing and sewing is undoubtedly correct, the reason that these acts are not abolished by the palsy of this muscle is explained by the vicarious action of other muscles in which the teres minor plays an important part.

Among other muscular symptoms the weakness in such movements of the arm as abduction, elevation in the sagittal and frontal planes, either singly or conjointly, have been frequently observed. This symptom, which seems out of proportion to the functional importance of these muscles, would apparently indicate that the supraspinatus is a more powerful synergist to the deltoid than it is usually considered to be; but the more plausible assumption seems that the movement of elevation becomes impaired and that a partial luxation of the head of the humerus from the loss of the suspensory action of the supraspinatus is either present or that pain attends this movement.

In other cases it is also probable that the circumflex nerve, which derives a portion of its fibres from the same cervical nerves as the suprascapular nerve, is simultaneously involved. These impairments in the various movements of the arm are the more evident in the earlier stages of the paralysis, as the vicarious action of the synergistic muscles tends to become established in the later stages of this affection. The muscles which assume such a vicarious action are the deltoid, trapezius for the supraspinatus, and the teres minor for the infraspinatus. This vicarious action of the deltoid, as well as that of the upper portion of the trapezius, was observed in one of the cases of Bernhardt; while in another

of his cases, as well as that of Steinhausen and of Sperling, a functional increase in the teres minor was noted.

The pathognomonic symptom of suprascapular paralysis remains the depression of the fossæ, which are occupied by the supraspinatus and infraspinatus muscles. It alone among all symptoms is constantly present, being invariably found in the latter stages of the affection, when, owing to the loss of innervation, the atrophy of the two muscles has progressed to a sufficient degree.

In the first stages of the disease it is, of course, absent, not appearing until probably six or eight weeks or more after the receipt of the injury to the nerve. The degree to which the atrophy of the muscles may progress is variable; in some cases the shallowness being referred to as a marked deepening or an evident depression, while in others the muscles, and especially the infraspinatus, seemed to be totally absent, the bone being felt beneath the integument, only a thin layer of tissue intervening between the two.

For the reason that the trapezius overlies the supraspinatus the atrophy of this muscle and the corresponding depression in the fossa it occupies is not as apparent as that of the infraspinatus.

The displacement of the scapula, which occurs in suprascapular paralysis, consists, according to Gowers, essentially of a rotation, so that the inferior angle is moved inward and upward. Duchenne gave for total suprascapular paralysis a direction of the median border of the scapula from below inward, upward, and outward. Bernhardt, on the other hand, found that in one of his cases the scapula of the affected side lay somewhat lower than that of the normal side, and its inner border was also directed more vertically and was farther distant from the vertebral column. In Sperling's case the scapula was rotated around the internal angle, so that the median border was directed from below externally upward and inward, and the inferior angle was approximated to the middle line.

In the case of Benzler a similar occurrence to that of Bernhardt was noted. In Steinhausen's observation both scapulas had the same position; while in Hoffman's the scapula of the affected side lay nearer to the vertebral column.

Whether scapular displacement can be stated to be a definite symptom of suprascapular paralysis seems doubtful. It would appear, however, that inaction of the arm or its more limited use, which would result from this paralysis or from the pain on the movement of the arm which attends this, could be a cause of a slight displacement. Displacement from this cause should manifest itself as downward, with a slight approximation toward the vertebral column, the inferior angle being displaced inward.

Another theory advanced for the scapular displacement is that this bone acquires a certain degree of fixation to the humerus by means of the tendons of the supraspinatus and infraspinatus, which points of fixation should tend to support the scapula in an inward and outward direction, so that, correspondingly with the paralysis of the muscles mentioned, the scapula drops slightly downward and inward. For the reason, however, that other muscles which are attached to the scapula would tend to counteract this predisposition, this assumption does not appear as probable.

There still remains to explain the displacement the presumption that, in the cases of so-termed isolated suprascapular paralysis, with partial displacement of the scapula, other muscles, such as the trapezius, may be to some extent involved—*i. e.*, somewhat weakened, whereby this symptom could most easily be accounted for. In instances in which other muscles were at first involved, and ultimately only the paralysis of the suprascapular group persisted, as in Goebel's case, this seems probable. When no such complications previously existed, other reasons must be sought for. That the slight displacement of the scapula occasionally exists, there is no reason to doubt. In no case, however, was the comparative position of the two scapulas ascertained before the injury. Normally the right scapula, owing to the more constant use of the right arm, does not in its position, size, or shape correspond to that of the left side, so that in the symmetry of the two bones alone a cause of this displacement primarily exists which is independent of the paralysis. As another cause the muscular weakness from the inaction of the arm has already

been mentioned. Both of these can be stated to represent the causes of the scapular displacement when present.

Of the symptoms of the nervous type, pain in the region of the shoulder-joint and anæsthesia over the scapular area have been mentioned. The former of these is inconstant and variable, being experienced while the arm is at rest or during its movements, and probably tending to disappear after the first stages of the affection.

Anæsthesia over the scapular area has been noted in a few cases. In Hoffman's case the sense of touch was decreased over the infraspinous fossa. Benzler and Sperling, on the other hand, report a spot of hyperæsthesia, about two centimetres distant from both the spine of the scapula and its vertebral border. Anæsthesia over the scapular area has also been noted by other observers.

To summarize the important symptoms of isolated suprascapularis paralysis in the order of their diagnostic importance, we have:

1. The depression or shallowness of the supraspinous and infraspinous fossæ.
2. The impairment of external rotation of the arm.
3. Frequently a weakness in the elevation or abduction of the arm.
4. A probable slight displacement of the scapula.

Diagnosis. In the differential diagnosis of this affection but few things need to be considered. When the depression of the supraspinous and infraspinous fossa is already present the diagnosis is apparent at the first glance, and there remains but the question whether these muscles are affected singly or whether other muscles are conjointly involved. In the earlier stages of this paralysis, however, when the atrophy of these two muscles does not yet give a definite indication as to the existing affection, the diagnosis may not be as easily established. Pain and the limited use of the arm, with a probable impairment in external rotation, are then present. These symptoms are, however, also common to other paralyses, as deltoid paralysis, as well as rheumatism and all inflammatory processes, articular or periarticular, etc.

In such instances in which the diagnosis is obscure a few successive examinations, in which the electrical reactions of the several groups of muscles surrounding the shoulder-joint is tested, should in time reveal the exact nature of the pathological condition present. It is apparent that the diagnosis cannot in all instances be immediately ascertained. On account of the rarity of this form of paralysis, it easily escapes detection unless its most important symptom—the depression of the supraspinous and infraspinous fossa—is very pronounced.

General Considerations and Treatment. I have not referred to the individual treatment of these paralyses during their consideration, since what applies to one is equally appropriate for all. The routine after-treatment in most cases has been the various antirheumatic preparations and, later, electricity, strychnine, and massage.

Regarding the treatment I can only say that where the cause is evidently a sudden traumatism, cold and rest are the most beneficial local measures during acute stages. It has been my desire not to advance any new or improved method of treatment, for the methods now in vogue have proven fairly satisfactory so far as medical measures go; but I have endeavored to point out in each case, so far as I was able, the synergistic action of other muscles, which might, by careful and intelligent development, be so exaggerated or altered in their functions as to take the place of those which are partially or totally paralyzed.

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AN UNUSUAL AND FATAL HEMORRHAGE FROM TREPHINING.

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It is generally considered that the operation of trephining *per se* is devoid of danger. The removal or temporary lifting of a considerable portion of the skull-cap for purposes of exploration is undertaken without thought of involving life. It is believed that in direct proportion to the extent of the intracranial portion of an operation is the danger of serious hemorrhage and shock increased. This is borne out by statistics. Thus, in the compilation of Haas of one hundred and twenty-two operations for brain tumor which were successful as regards the removal of a tumor, there was a mortality of 61 per cent. The death rate is largely charged to shock and hemorrhage.

In the two years 1900 and 1901 v. Bergmann operated on four tumors, with three deaths directly due to operation. That the hemicraniotomy, the opening of the skull by the large trap-door method, and the operation at one sitting, are in part accountable for this high death rate is probable. In the larger work of v. Bergmann on brain surgery twelve deaths had been reported directly due to hemorrhage. The proportion of cases in which excessive hemorrhage came from the skull is difficult to determine. Of one hundred and seventy-five exploratory or palliative operations in which the tumor was not found or could not be removed, seventy-five ended fatally.

In the literature of the subject deaths on the table have been often recorded without specific designation of the source of the bleeding. In brain tumors involving the dura and the bone capsule excessive bleeding is to be expected. That changes in the diploic veins should occasionally take place is not strange when one considers the relationship between the dural sinuses, the cortical meningeal veins, and the parasinoidal spaces as demonstrated by Cushing. In a personal communication from Dr. William T. Taylor he states that he has seen only two of Dr. Keen's cases of dural tumor survive the operation. Hemorrhages carried off the other cases in the course of a few hours.

In a personal communication from Dr. Allen Starr he reports a case operated upon at the Presbyterian Hospital for supposed cerebellar tumor. On stripping off the scalp, a large horseshoe incision having been made over the occiput, the hemorrhage was severe. When the pericranium was exposed a series of little holes in the skull was opened, from which venous blood poured out. The diploic veins connected with the lateral sinus; they were enormous and opened outward. The operation was discontinued, the hemorrhage being controlled with difficulty by pressure. The patient recovered from the operation, but did not report subsequently.

In another case, at the New York Hospital, Dr. Peabody exposed a fibroma one inch beneath the cortex of the parietal region. Over this tumor the skull was reduced in thickness, so that it was not one-eighth of an inch thick over a region two inches in diameter. Here the man had felt pain, and it was exquisitely tender. But one inch of brain tissue of apparently normal consistency lay between the tumor and this thin skull. Dr. Starr further states that he has seen two cases of brain tumor in which the skull over the growth was thicker than elsewhere.

So far as my knowledge of the literature goes, no great changes in the skull have been depicted as secondary to subdural brain tumors, except for the involvement of the dura and overlying bone from extension of the disease. The following case of death from hemorrhage from the bone only, and a description of the changes found on autopsy, may prove of interest:

Miss A. M., aged thirty years, single, entered Cincinnati Hospital December 22, 1902. The family history is negative. The patient has been well up to the present time, except for an attack of measles in childhood. Two years before admittance patient began having epileptic seizures, in which the right arm would begin to tremble and contract; then the right side of the face and the right leg would become rigid and tremble. The patient usually lost consciousness. These attacks occurred on an average once a week. She was brought to the hospital several months ago, and the diagnosis of tumor in the left cortex was made. The patient refused operation, and left the hospital. The fits continued to occur weekly.

Present Condition. Patient of small stature, fairly developed and well nourished. On the face there is a typical iodine eruption. Heart sounds normal. Mentally the patient is fairly bright, but at times shows marked hebetude. She complains of almost constant headache. Movements of the eye normal. Reflex present both to light and accommodation, otherwise the examination is negative. The ophthalmoscopic examination made by Dr. Satler shows typical papillitis, prominent swelling of optic nerve entrance, with exudation and hemorrhage, œdema of the disk, œdematous infiltration of region of macula, likewise slight hemorrhage. The papillitis, which has been present for a length of time, is beginning to recede and give way to optic atrophy.

During her stay in the house a number of epileptic seizures were carefully observed. They began with pain in the right arm, which was a precursor of the attack. Within five minutes usually the pain increased, and the arm became rigid and trembled. The face and right lower extremity were next involved, and became rigid. In a number of attacks unconsciousness, lasting for a varying length of time, followed. During the attacks the pulse rate increased to 120, but within an hour after its termination it was down to 84.

Operation January 28, 1903. Morphine-chloroform narcosis. The Rolandic fissure having been outlined, a large horseshoe-shaped incision of the scalp, with lower base, was made down to the bone. The bleeding from the scalp was not unusual. With the Kummel electric drill an opening was made through the skull.

The bleeding was quite profuse. The smallest Sudek fraise was next inserted, with a view of making an osteoplastic resection of the skull in the line of the scalp incision. About one inch of bone had been cut through when it was evident that the profuseness of the hemorrhage from the bone would prevent the completion of the operation by this method. The fraise was, therefore, removed, and bone wax was pressed into the line of the cut in the bone. The hemorrhage was not thereby controlled. Compression of both carotids was likewise tried, but was of no avail. As speedily as possible a large trephine opening was then made, the scalp and periosteum having been rapidly lifted from the bone. With rongeur forceps the bone was removed as rapidly as possible, in order to get at the source of the bleeding. In the meantime the patient became blanched and pulseless. She died after the dura was exposed. The autopsy revealed a gliosarcoma, the size of a small peach, directly under the trephine opening. The tumor could easily have been lifted out from between the convolutions. It was not adherent to the dura. The original intention to operate at two sittings was frustrated by the death on the table from hemorrhage from the bone. The skull-cap was removed, and the following changes noted by Dr. A. V. Phelps, Professor of Anatomy in the University of Cincinnati, who was kind enough to make a very careful study of the effects on the bone of the marked disturbance of the intracranial venous circulation.

Report of Dr. Phelps.

Dr. Joseph Ransohoff.

Dear Doctor: The cranial vault you sent to me for examination shows the effect of marked disturbance of the intracranial venous circulation.

The groove for the lodgement of the superior longitudinal sinus, anterior to a point midway between the lambdoid and coronal sutures, is much widened, being 4 cm. wide on the frontal bone, where it should be a mere trace. The margins of the groove are scalloped, showing where the much-distended lacunæ laterales of Keyes and Retzius pressed upon the bone.

Posterior to the point above taken, and almost opposite to the posterior pole of the trephine opening, the groove for the longitudinal sinus abruptly narrows, being 1 cm., and appears normal. Anterior to the transverse plane of the above point, lateral to the groove and in the groove for the sinus, are numerous openings, greatly enlarged foramina, through which the dural veins and the diploic veins anastomose.

The most remarkable changes, however, are the bony canals for the diploic veins. This change is almost limited to the left side—the side of operation. Remembering that the occipital diploic veins are much the largest, and noting that in the specimen they are normal, their opening may be used as a standard of comparison:

1. The frontal diploic canal of the left side, usually very small, is as large as the occipital.

2. The canals carrying the frontal branches of the anterior temporal diploic veins are 2 mm. in diameter, and appear to be five times as large as the occipital. The bony tables over them are so thinned that one can trace the canals. They open on the edges of the trephine opening.

3. One canal—the parietal branch of the anterior temporal diploic vein—is 5 mm. diameter, and appears to be ten to twelve times as large as the occipital. Its coverings are almost transparent, and it opens directly in the margin of the trephine opening, having crossed the field of operation.

4. The posterior temporal diploic canal is about four times as large as the occipital.

5. On the right side only the temporal canals for diploic veins are enlarged to about the size of the normal occipital only.

About opposite the middle of the trephine opening, and just to the left of the sagittal suture, the bone is so thinned as to be transparent. It would appear that the growth interfered with the flow through the superior longitudinal sinus, and the veins of the dura and their lacunæ laterals became distended. The anterior temporal diploic vein anastomoses with the dural veins, and empties by coming out through the great wing of the sphenoid and entering one of the deep temporal veins. It would appear that this great

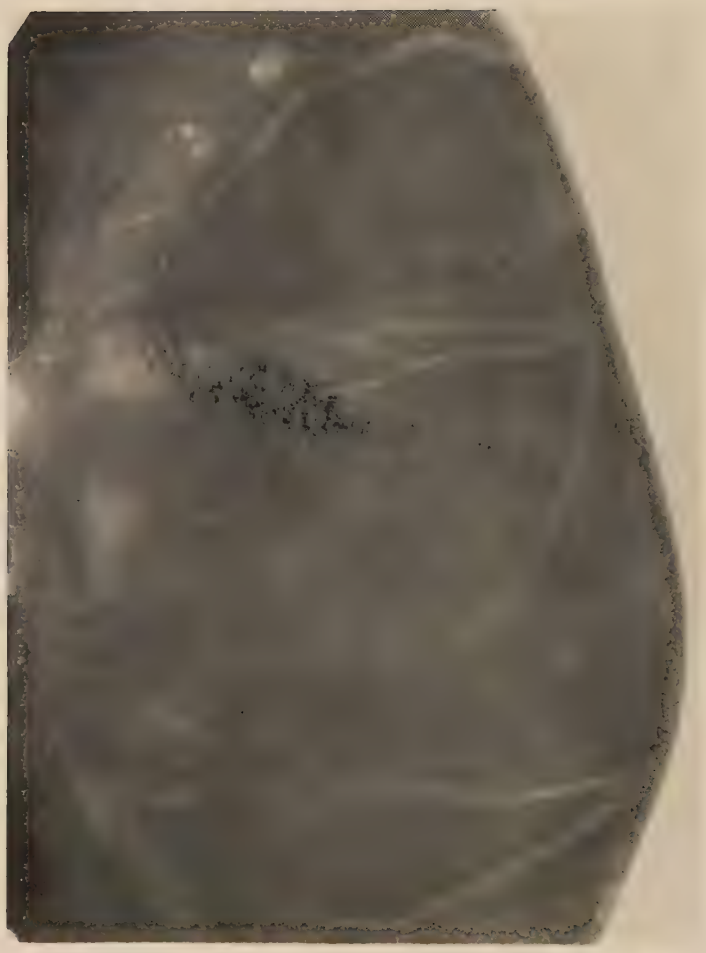
diploic vein became the principal channel of collateral circulation.

The left diploic veins were more enlarged, because the dural veins with which they anastomosed were directly pressed upon as well as the sinus. Fewer of the meningeal veins anastomosing with the posterior temporal, the diploic veins were pressed upon; therefore its enlargement is less than that of the anterior. It empties either through the mastoid opening or goes inward to the lateral sinus.

In the case reported the first symptoms manifested themselves two years before the operation. The growth, therefore, was rather rapid in its development, and marked changes in the diploic veins must be considered as very unusual. From the very nature of things it is impossible to predict such a complication in a contemplated operation for brain tumor, except when it is evident that dural tumors have infiltrated the bone. In these cases hemorrhage is to be expected. That the increased general intracranial pressure from clearly subdural tumors, as in the above case and that mentioned by Starr, is capable of inducing marked dilatation of the diploic veins and the parasinoidal lacunæ must be borne in mind. It certainly accounts for the greater hemorrhage during the operation of trephining for tumor than for other pathological conditions.

The case presented was the first in which I attempted the use of the electric fraise with the intention of doing an osteoplastic resection. While it is impossible to be certain that the result would have been different had I adopted the older methods of operating with trephine and chisel, I am quite certain that valuable time was lost in getting at the source of the bleeding. Posture of the head and compression of the carotids availed nothing.

In a few cases recorded, among them one of my own, the ligation of the carotids was made necessary by the profuseness of the bleeding. It is difficult to see how in a case like the one recorded, anything short of tying both carotids would have availed. This patient was dead from hemorrhage before the carotid could have been exposed.



THE TREATMENT OF SURGICAL SHOCK BY ADRENALIN.

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REICHERT has shown that adrenalin intravenously injected is a direct stimulant to the heart and to both the centric and peripheral vasomotor system. He also notes that it is a stimulant to the respiratory centre, and that it increases general metabolism and body temperature. The brilliant experiments of Crile and others corroborate these findings, and point even more forcibly toward adrenalin as a potent medication in the treatment of shock or collapse. It is evident, moreover, that, in so far as its immediate lethal effects are concerned, the drug is not markedly toxic—at least in the doses which would ordinarily be administered—since while 0.0005 drachm will markedly increase the blood pressure, this dose repeated a hundredfold simply accentuates this increase, nor is there subsequently a compensating drop. These, however, are laboratory findings. There are some others of great importance, the first in regard to the toxicity of the drug.

While investigators along this line were compelled to use extracts of the gland itself—these extracts being made and purified in various ways, yielding products of varying strength and purity—it is only reasonable to suppose that there would be among them marked differences in the results obtained. To such causes may be due the contradictory statements regarding the lethal dose, its action on the central or peripheral nervous system, the final cause of death.

More recently, however, several preparations of the active blood-pressure-raising constituent of the suprarenal gland have been available. These, if not exact chemical counterparts, are approximately so, and have enabled us to determine more accurately and broadly the effect of the substance when introduced, either directly or indirectly, into the blood supply of an animal.

In spite of certain contradictions, some facts would seem to be fairly well established. For example, for rabbits and guinea-pigs the lethal dose of adrenalin hydrochloride, by way of the jugular, is 0.0002 gramme per kilo. When injected into the femoral artery of a rabbit the dose is 0.0006 gramme per kilo; subcutaneously the dose is 0.010 gramme per kilo. Death generally ensues within the hour, rarely after six or seven hours. Frogs require 0.010 gramme per kilo and death is due to a paralysis of the nerve centres. These results suggest that the dosage of adrenalin employed in medicine may be increased a hundredfold with safety.

Rabbits killed by adrenalin hydrochloride show at autopsy an acute pulmonary œdema (Battelli and Taramasio, *Soc. de Biol.*, vol. liv. p. 815) if death is prompt. If the animals survive more than fifteen hours, they die not of a direct adrenalin action, but of an infection which is manifested in the form of a wet gangrene at the seat of inoculation.

The production of a bacterial gangrene in rabbits, when adrenalin is injected subcutaneously just prior to an infection with streptococcus, is mentioned by Garnier (*Ibid.*, p. 1440). Death follows in five to eight days. If, however, the adrenalin is injected after the streptococcus infection is established, gangrene is not produced. The presence of gangrene would readily be explained by the pronounced ischæmia of the tissues, but why the administration of adrenalin after the infection should result negatively is somewhat obscure.

According to Battelli (*Ibid.*, p. 1435), adrenalin treated with an alkali in the presence of oxygen is transformed into oxyadrenalin—a substance which is without action on blood pressure. In a later experiment (*Ibid.*, p. 1518), by establishing an artificial circulation

through the liver with blood containing 1 : 500,000 adrenalin, he finds the issuing blood without pressure-raising properties. The active agent in this change would appear to be the red blood corpuscles. Hence he believes it to be essentially a process of oxidation, and calls attention to the fact that after the blood pressure has returned to normal, or even below it, following the injection of adrenalin, there is an abundance of the drug to be found in the blood.

Another phase of the fate of adrenalin in the organism has been studied by Carnot and Josserand (*Ibid.*, vol. lv. p. 51), who, having noted that the dose of adrenalin when injected into an artery must be trebled as compared with the venous dose, tried the action of adrenalin on muscles which had been exhausted by a prolonged faradic current. Under such conditions a dose of 0.055 milligramme per kilo injected into the femoral artery of a fatigued leg caused a rise of 1.5 cm. of mercury, while the leg of the opposite side at rest gave a rise of 11 cm. The struggles of an animal on the operating-table are said to quite neutralize small doses of the drug. Such experiments indicate that the stimulating influence of adrenalin will necessarily be transient, and will be manifested imperfectly or not at all unless the drug is driven directly into the venous circulation.

That the active principle of the suprarenal gland has a profound action on chemical processes is illustrated by the work of Herter and Wakeman (*Virchow's Arch.*, 169, p. 479), who caused a marked temporary glycosuria by its injection into dogs. The animals which died showed pancreatic necroses and hemorrhages.

Before employing adrenalin chloride on the human subject it is well to determine the surgical cleanliness of the preparation, its bactericidal effect, if any, and its influence upon the bacteriolytic powers of the blood. Adrenalin chloride, being put up in 1 : 1000 solution containing 0.5 per cent. chloretone, is necessarily antiseptic.

A sample of adrenalin in powdered form was obtained. This was dissolved in sterile salt solution, in the proportion of 1 : 10,000, and so used.

The results were practically the same with the "Adrenalin" of Parke, Davis & Co., the "Hæmostatin" of Wampole & Co., and the solution made by us from the powdered adrenalin obtained from Parke, Davis & Co.

The culture tubes contained the above solution of adrenalin diluted as desired with physiological salt solution and 0.1 c.c. of bouillon, making in each case a total volume of 1 c.c. The "controls" were 0.8 per cent. salt solution and bouillon. The tubes were seeded from suspensions running over 40,000 to the *oese*, young colonies being used. Successive platings on agar, as indicated in the tables, and a count of the colonies which developed, showed the action of the adrenalin. The organisms used for experiment were B. coli, B. pyocyaneus, and staphylococcus pyogenes aureus.

Adrenalin mixed with salt solution and bouillon, in the proportion of 1 : 100,000 and 1 : 40,000, would appear to very slightly retard the growth of the organism until between the third and fifth hours, when there is a marked rise; and at the expiration of the fifth hour the adrenalin culture contains a greater number of organisms than does the control, a difference which is usually more exaggerated at the expiration of twenty-four hours. In the proportion of 1 : 20,000 adrenalin seems to retard the multiplication of the organisms even at the expiration of twenty-four hours, though the inhibitory action is but slight and sometimes fails completely.

Cultures were also made using adrenalin in salt solution in the proportion of 1 : 100,000 and 1 : 40,000, discarding the 0.1 c.c. of bouillon and comparing the growth under such conditions with that in physiological salt alone. The latter became sterile in twenty-four hours; the adrenalin tube containing 1 : 100,000 at the expiration of the same period showed several hundred organisms to the loop. Adrenalin in the proportion of 1 : 40,000 gave no growth. This behavior recalls that of such simple amido bodies as asparagin, which in very dilute solution favors bacterial growth, while in larger quantities it retards it.

A more accurate idea of the foregoing statements may be obtained from the following protocols:

TABLE I. ADRENALIN WITH SALT SOLUTION AND BOUILLON.

B. coli.	*Immediate.*	1 *hour.*	3 *hours.*	5 *hours.*	24 *hours.*
Suspension	40,000	...	...	.....	.....
Control	114	116	702	9,802	43,830
1 : 100,000	240	118	460	9,680	56,646
1 : 40,000	112	100	540	11,693	49.937
1 : 20,000	183	127	659	1,132	38,936

B. pyocyaneus.	*Immediate.*	5 *hours.*	24 *hours.*
Suspension	50,000	.....	.....
Control	651	2,326	40,000
1 : 100,000	901	2,990	innumerable
1 : 40,000	657	1,407	"
1 : 20,000	355	790	80,000

Staph. pyog. aur.	*Immediate.*	5 *hours.*	24 *hours.*
Suspension	90,000	.....	.....
Control	245	4,181	34,762
1 : 100,000	213	11,118	innumerable
1 : 40,000	284	6,110	"
1 : 20,000	200	2,215	29,394

TABLE II. ADRENALIN AND SALT SOLUTION.

B. coli.	*Immediate.*	1 *hour.*	3 *hours.*	5 *hours.*	24 *hours.*
Suspension	40,000	...	...	...	...
Sodium chloride	111	79	106	17	sterile
Adrenalin, 1 : 100,000	123	55	82	130	335
1 : 40,000	127	185	sterile	sterile	

The bacteriolytic action of blood serum containing small quantities of adrenalin has been tested by two experiments upon the B. coli. While it is distinctly desirable that further work should be done before making any generalizations, the outcome of these two trials has been a marked loss of bacteriolytic power. The serum was obtained from the rabbit. Each tube contained 0.5 c.c. of serum and 1 c.c. of bouillon, with sufficient 0.8 per cent. salt solution and adrenalin solution to make a total volume 1 c.c.

TABLE III. BLOOD SERUM AND ADRENALIN.

B. coli.		*Immediate.*	1 *hour.*	3 *hours.*	5 *hours.*	24 *hours.*
Suspension	A	46,080	...	...	...	...
	B	50,300	...	...	...	...
Control	A	289	115	583	18,630	95,850
	B	272	197	920	15,840	112,860
1 : 100,000	A	366	209	932	54,560	innumerable
	B	247	83	574	31,030	"
1 : 40,000	A	289	183	618	38,250	"
	B	183	117	671	40,130	"
1 : 20,000	A	293	203	892	53,760	"
	B	153	118	666	43,200	"

As to the physiological action of adrenalin, the following experiment is quite typical of results that may be obtained in the laboratory:

A dog weighing 14 kilos was killed by ether. The chest and pericardium were then opened, and artificial respiration was started. The blood pressure remained at the abscissa line, and there were no cardiac motions visible for fifteen minutes. A 1 : 10,000 adrenalin chloride solution, running at the rate of about 12 c.c. to the minute, was then allowed to flow from the burette by gravity into the external jugular vein, the pumping action of the heart being established by grasping this organ in the hand and making forceful and rhythmical pressure. Feeble contractions were noted for several minutes before regular, normal pulsations were re-established. These contractures had apparently no effect upon blood pressure, but are distinctly recorded in the tracing. They were reinforced frequently by manual pressure. In a few minutes the heart began to beat with normal vigor. The blood pressure rapidly rose under repeated injections of adrenalin, reaching to above normal, and respiratory efforts were resumed. Thereafter with each injection of adrenalin there was a prompt jump in the pressure, followed in a few minutes by a gradual fall to normal, but not below.

One tracing shows a secondary rise without a further administration of the drug. Garnier has already called attention to this phenomenon, which a complete tracing might show as constant. No attempt was made to keep up the body temperature, and there was, incident to the high blood pressure, an almost constant hemorrhage from the thoracic wound. In consequence of these conditions there was a slight but steady fall in blood pressure. The absence of a compensating drop after a high rise was especially noteworthy.

We finally attempted to kill the dog with large doses of adrenalin, administering twice 40 c.c. of a 1 : 10,000 solution. After 137 c.c. had been given, two hours and thirty-eight minutes from the beginning of the experiment, as it seemed that life might be prolonged several hours, chloroform was injected into the external

jugular vein. Our efforts to resuscitate one or more hours after death have thus far proven futile, even though the body temperature was carefully maintained.

As to the clinical side of the question, adrenalin chloride was used during the last month in six cases, all exhibiting symptoms of impending death. I did not feel that our knowledge of its powers or toxicity was such as to justify its employment in cases in which there was even a slight hope of success by other methods.

Case I.—Boy, aged nine years, sustained a crush of the lower third of both thighs, and was brought to the hospital cold, pulseless, and gasping. Two drachms of adrenalin were given in a half-pint of normal salt solution by subcutaneous injection. The immediate increase in blood pressure was probably due to the stimulating effect of hope and enthusiasm upon the observing faculties of the attending surgeon, since the patient died ten minutes after the hypodermoclysis was begun.

Case II.—A woman, aged sixty-seven years, because of extensive carcinoma, was subjected to an excision of six inches of the ileum and the ascending and one-half the transverse colon. Associated with an almost imperceptible pulse of 150 were the respiratory signs of impending death. 4 c.c. of adrenalin chloride, 1 : 1000, were given subcutaneously in one pint of normal saline. In ten minutes the pulse dropped to 100, and was of good quality. An hour later, because of a feeble running pulse, this treatment was repeated, and with similar success. This patient lived for five days, dying apparently of progressive septicæmia.

Case III.—R. K., aged forty-two years, was referred from the medical wards of the Philadelphia Hospital because of a tender, painful abdomen and a hard and irreducible inflamed scrotal hernia. There was fecal vomiting and constipation. Operation showed a strangulated hernia bathed in a purulent exudate. The gut was covered with a white, adherent membrane, which was stripped from the intestine. The gut was thoroughly irrigated with normal salt solution, returned to the abdominal cavity, and a

radical cure was performed, and drainage was provided for by a tube and gauze. This patient subsequently developed bronchial pneumonia. He died five days later. On the last two days of his life, because of a running and progressively weaker pulse, he received 4 c.c. of adrenalin chloride in half a pint of salt solution every two hours by hypodermoclysis. In all seventeen doses were given. There was no distinct effect produced upon the pulse.

Case IV.—E. S., aged six years. Typhoid perforation, twenty-six hours old. On operation, one hour from admission to the surgical service, the patient having been quietly and properly etherized, the pulse was running at 160, extremely weak; the extremities were cold and mottled. During the operation one-half pint of normal salt solution, containing 4 c.c. drachms of adrenalin chloride, 1 : 1000, was given by hypodermoclysis. During suture of the external wound the patient's pulse was running to over 180, the breathing had become gasping, the skin was blue and wet, and the signs of impending death were most marked; 1½ c.c. of adrenalin chloride in 1 : 10,000 dilution were injected into the median cephalic vein. Within two minutes there was a prompt response, the tension of the pulse increasing markedly, and the rate dropping to 160. A red flush appeared on the face, the extremities became warm, and the condition of the child on being returned to bed was much better than it was at the beginning of etherization. On the second day temperature had dropped to 99° F. and the pulse to 100. There was abundant discharge from the drainage tubes, and it looked as though recovery might take place, since food was taken and retained, and the bowels opened freely. A septic condition, however, continued, and the child died in seven days from operation.

An autopsy showed that there was no attempt at repair, either in the parietal wound or in the peritoneal cavity. The latter was filled throughout with a thin, purulent exudate under no tension. The only adhesions found were those at the point of perforation covering the stitches.

Case V.—F. W., aged fifty years, because of osteomyelitis following operation on ununited fracture, was admitted to Dr.

White's wards, and was subject to a hip-joint amputation. During the course of this there was difficulty with the respiration, and the patient rapidly dropped into a condition of profound collapse, the pulse running at 150. A pint of normal saline, containing one drachm of adrenalin chloride, 1 : 1000 solution, was given by hypodermoclysis. The absorption was, however, extremely slow, and the pulse became weaker, irregular, and more rapid, running at 160. Fifteen minutes later a second subcutaneous injection of adrenalin, 1 drachm in a pint of normal saline solution, was administered, and though there was no perceptible effect on the pulse rate, it seemed to improve in quality. An hour later 2½ drachms of adrenalin chloride were given in a pint of normal saline solution. This was followed by distinct increase in force and regularity. In addition to the adrenalin this patient was given freely alcohol, strychnine, digitalis, and coffee. Temperature remained high, but the pulse notably came down until, fifteen hours after operation, it was running at 138. Two drachms of adrenalin were given in a half-pint of salt solution. The absorption was slow. In one and one-half hours a pulse of high tension was running into 180, but two hours later it came down to 140. Twenty-six hours after operation pulse 140, temperature 102° F., the respiration 30. Two drachms of adrenalin were given as before. In fifteen minutes the pulse was 180, but the next three hours had dropped to 144. This patient died of sepsis seven days after operation. There was very extensive sloughing of the wound, but the skin edges had united. 112 was the lowest point reached by the pulse, three days after operation; 8½ drachms of adrenalin were given.

The last case—one of typhoid perforation—came to the table with a pulse of 180. An intravenous adrenalin injection was without effect; it is uncertain whether or not any of the drug was introduced into the circulation, since it was administered by an inexperienced hand.

In two of these cases the effect of the adrenalin was immediate and unmistakable; in both it seemed life-saving.

But the clinical evidence I have produced as to its effect must

be regarded as inconclusive on all points. It was not employed on a single patient in which there was a fair prospect of the preservation of life without its use; hence the unbroken mortality of my series of cases cannot be counted against it. One case of typhoid perforation apparently speaks strongly in its favor, since I have never seen a surgical patient so profoundly septic and collapsed make an operative recovery. This one case, however, must be corroborated by many others before confidence may be placed in the drug.

Laboratory experiments apparently show that adrenalin by intravenous injection is the most powerful, practicable cardiac and vasomotor stimulant yet presented to the profession. Its value is still further enhanced by the fact that it stimulates the respiratory centre and increases general metabolism and body temperature.

The toxic dose for man is not known, but is probably several hundred times greater than that in which the drug is ordinarily given.

Because of the rapidity with which it undergoes alteration in the body, it is inert in so far as its systemic effect is concerned when given either by the mouth or by the rectum.

Because of the tendency to abscess formation at the seat of injection incident to the ischæmia caused by strong solution, the dilution should be at least 1 : 10,000 when the drug is given hypodermically. Nor does it seem probable that any effect can be expected, when thus administered, from less than 2 c.c. of the 1 : 1000 solution. Apparently it is safe to give an initial dose of 10 c.c. of the strong solution in 90 c.c. of normal salt.

In cases of urgency adrenalin chloride should be given intravenously in a dilution of 1 : 10,000. The injection should be slow, thus prolonging the effect of the drug, and should be pushed up to 100 c.c. of the strong solution or until the heart clearly and unmistakably responds to its influence.

There is as yet no convincing clinical proof to the effect that the drug is as efficacious when used on man as laboratory experiments would lead us to suppose.

Because of its power of lessening the bacteriolytic power of the blood of animals, its use in cases of infection in the human should be practised with great caution until a wider experience has proven its safety or danger in these cases. Clinical evidence strongly suggests that it exerts a similar power upon the blood of man.

INTESTINAL PERFORATION IN TYPHOID FEVER.

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AND

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Although perforation of the intestines from ulceration has been recognized from early times, as may be seen in the occasional reports of autopsies,[1] yet it was not until about seventy years ago, when typhoid fever became clearly known as an individual disease, that many of these lesions were referred to it as a cause. And not until 1884 was surgical interference suggested as a forlorn hope in snatching a few of these patients from the jaws of death.

It was Leyden who first advocated laparotomy for this condition, and the first recorded operation was done by Mikulicz on April 7, 1884. The patient, a man aged forty years, was suddenly seized, while apparently in perfect health, with symptoms of intestinal perforation. After a lapse of seventy-two hours laparotomy was done through a median incision, and a perforation found and sutured. Pieces of potato were floating about in the man's belly. After a rather tedious convalescence, the patient ultimately recovered (Volkmann's *Samml. klin. Vortrage*, No. 262; *Chirurgie*, April, 1884, No. 83). It was an ambulatory form of the disease, the existence of typhoid fever being not apparently suspected before operation. This case has been rejected by some authors as not authentically one of typhoid fever, but it has been accepted by Dr.

[1] Morgagni, De sedibus et causis morborum, Epist. i., art. 2; Berthomieu, Annales de la médecine physiologique, Paris, 1822, i., 392–398; Corrin, Archives générales de médecine, Paris, 1831, xxv., 36–60; Ramsay, American Journal of the Medical Sciences, 1836, xviii., 52; Louis, Archives générales de médecine, Paris, 1823, i., 17–49; Howship, Pract. Obs. in Surgery, London, 1816, p. 264; etc.

Keen and by Dr. Finney, among other writers on the subject, and a perusal of the original report leaves no doubt at all in our own minds as to the propriety of including it in the statistics of this operation.

For the first five years only ten of these operations are recorded, and, indeed, a mortality of 90 per cent. was not at all encouraging. But the 16 cases subjected to operation during the second lustrum showed a death rate of 87.5 per cent., while during the period from 1894 to 1898, inclusive, the mortality of the operation had been reduced to 72 per cent. This is probably still the death rate, although of cases recorded since 1898 less than 70 per cent. have terminated fatally; but no statistician, however enthusiastic, can afford to ignore those cases, mostly fatal, which are never reported at all, and must, therefore, allow a fairly wide margin in drawing conclusions from the figures available.

We have carefully examined in all the records of 362 patients, who, during the course of typhoid fever, submitted to laparotomy for intestinal perforation, or for peritonitis without actual perforation. From our tables we have excluded several cases where an operation was not performed until some time after recovery from typhoid fever, and also a very few cases accepted by previous writers on the subject, in which study of the original records has convinced us that the evidence did not warrant their inclusion. We have freely consulted the works of Keen, of Finney, of Hagopoff, of Miclescu, and of others; also the theses of Mauger, of Junqua, and of others; as well as numerous articles of less extent, among which mention may be made of those by Shattuck, Warren and Cobb, Bontecou, Munro, Monod and Vanverts, Briggs, Cushing, Abbe, Shepherd, Hays, and Hartmann; to all of which we desire to express our indebtedness. We have consulted the original reference in every case in which it was accessible to us, and in other instances have taken pains to indicate the medium of our knowledge.

Perforation of the intestines is said to occur in from 1 to 11 per cent. of cases of typhoid fever. Leibermeister, in 2000 patients, found perforation in 26; Murchison, in 1580 patients, observed it

48 times; Griesinger, in 118, noted 14 perforations; while Flint, in 73 cases, found but 2 (these figures are from Hutchinson, in Pepper's *System of Medicine by American Authors*, Philadelphia, 1885, vol. i.). Curschmann, in Nothnagel's *Encyclopædia*, Philadelphia, 1901, found that of 829 patients 2.7 per cent. perforated. Armstrong, in the Montreal General Hospital (*Annals of Surgery*, November, 1902), observed among 932 patients an incidence of 3.66 per cent. At the Episcopal Hospital in this city we have examined the records since January 1, 1898, and find that, among 1556 patients treated for typhoid fever in that time, at least 34 perforations occurred; and at the Pennsylvania Hospital, among 1793 cases, 45 perforations are recorded.

These figures may be compendiously seen in the annexed table:

Authority.	Cases.	Perforations.	Percentage.
Leibermeister	2000	26	1.3
Murchison	1580	48	3.03
Griesinger	118	14	11.01
Flint	73	2	2.7
Curschmann	829	22	2.7
Montreal General Hospital	932	34	3.66
Episcopal Hospital	1556	34	2.18
Pennsylvania Hospital	1793	45	2.5
Total	8881	225	2.54

Causes.

The causes of perforation are numerous. As those predisposing to this lesion may be discussed: race, sex, age, season, geographical location, stage of the disease, severity of the attack, intestinal parasites, etc. It may in general terms be said that the white *race* is more disposed to perforation than is the negro race, but sufficient statistics on this point have not been collected to enable us to speak with certainty. The male *sex* is more liable to suffer perforation than the female in the ratio of about four to one. Of 279 cases in which the *age* is known, over 12 per cent. occurred in patients under fifteen years of age, over 54 per cent. between fifteen and thirty years, and only 33.6 per cent. over thirty years of age. *Season* and *geographical location* have little influence in predisposing to perforation, although, of course, more perforations are apt to occur in the summer and autumn months in this

latitude, because there are more cases of typhoid fever at these seasons. It would seem also that in warm and semitropical climates this complication is somewhat more unusual than in temperate and cold climates; at least, the majority of reported cases occurred in the United States, Great Britain, France, Germany, and the northern parts of Russia, although cases have occurred in Italy, in Constantinople, and other southern climates. In Mexico it is said to be very unusual.

Intestinal parasites may act as a predisposing cause, and even rarely as an exciting cause. Most of the earlier cases of perforation of the stomach reported were due to intestinal worms, and it seems not improbable that many cases of intestinal perforation reported during the last part of the eighteenth and early part of the nineteenth century as caused by worms were, in reality, in patients suffering from typhoid fever, the physician's attention at the autopsy being drawn away from the mucous surface of the intestines by both the parasites and the extensive peritonitis. Out of 932 cases of typhoid perforation reported as above stated by Armstrong, two had intestinal worms. We have not ourselves observed this complication.

Stage of Disease. Out of 286 cases in which is known the stage of disease at which perforation occurred, only 6, or about 2 per cent., took place in the first week. The second and third weeks witnessed 162 perforations, or 56.6 per cent., of the whole number; while after the end of the third week only 41.2 per cent. occurred.

Severity of Disease. It has been stated that perforation is more apt to occur in the mild than in the aggravated form of the disease. Dr. George B. Wood[1] expressed himself of this opinion; Curschmann says perforation is more frequent in ambulatory and mild cases, also among the lower classes, for the same reason, namely, lack of proper care;[2] and Osler says: "There is certainly no relation between this accident and the severity of the disease."[3] But, on the other hand, Hutchinson[4] claims that in a large pro-

[1] Practice of Medicine, fourth edition, vol. i. p. 329.
[2] Nothnagel's Encyclopædia, loc. cit.
[3] Principles and Practice of Medicine, New York, 1899.
[4] Pepper's System, loc. cit.

portion of cases it occurs in grave cases, and Osler himself, in a later utterance,[1] reverses his opinion by stating that perforation usually occurs in the more severe cases. This is a point which it is difficult to determine; because many ambulatory cases would never be seen in hospitals at all, unless perforation had occurred; and because when perforation does occur in very severe cases it is often extremely difficult to diagnose, on account of the apathy or hebetude of the patient; and it thus not infrequently happens that a perforation is unexpectedly found at autopsy, when it had been thought that the patient had died merely from the toxæmia incident to a prolonged course of the disease. Moreover, we recollect in after years chiefly those cases where the perforation comes contrary to all expectations; while those patients in whom its advent is hourly anticipated do not create so lasting an impression on our minds. We are, therefore, of the opinion that, although perforation certainly does occur most unexpectedly in some patients, and although in patients who have already reached the stage of convalescence, and in those suffering from an ambulatory form of the disease, its occurrence has frequently been observed, yet that in the majority of instances it is a lesion of the severer forms of the disease, and that it is in these cases that preventive measures, such as they are, should be employed. In connection with the severity of the disease, the existence of *tympany* as a predisposing cause of perforation may be considered. Where ulceration of the bowels is extensive, and tympany coexists, there is every reason to believe that perforation is more apt to be produced by mechanical causes, such as a sudden turn in the bed, etc., than in cases where the intestines are comparatively flaccid. The condition of the intestinal walls themselves is, of course, of importance as a predisposing cause: attention has recently been called to the action of the thrombi so frequently observed beneath the serous coat of the bowels in typhoid fever, and it has been asserted[2] that they act as a factor favoring the occurrence of

[1] Philadelphia Medical Journal, January 19, 1901.

[2] Yates, American Medicine, May 2, 1903.

peritonitis without perforation, and, it seems reasonable to infer, also, in predisposing to perforation.

Exciting Causes. The exciting causes are chiefly those which act mechanically. Anything, in fact, which sets up unusual peristaltic action is liable to cause a solution of continuity in the already damaged intestines; among these, indiscretions in diet probably hold first place; then purges injudiciously administered, a large or too forceful an enema, a sudden motion in the bed, straining on the bed-pan, the almost involuntary contraction of the abdominal muscles produced by the physical shock of the cold bath, each one of these and others have been held responsible for the immediate onset of symptoms of perforation.

Pathology.

The lesions of the intestine in typhoid fever consist, as is well known, mainly of changes in the lymphoid tissue found in greatest abundance in the lower part of the ileum. In the first week or ten days of the disease the intestinal lymph nodes are swollen, Peyer's patches being, as a rule, affected earlier than the solitary glands. This swelling consists, as has recently been shown by Mallory,[1] of Boston, chiefly in a proliferation of the endothelial cells of the lymph and bloodvessels; these endothelial cells show a marked tendency to gorge themselves with lymph cells (lymphocytes), thus constituting the pathognomonic "typhoid cells." It is to be observed that a large number of polymorphonuclear leucocytes does not collect until either a mixed infection has arisen or until the typhoid germs have taken on pyogenetic properties, so that in the early stages of the disease there is not usually an appreciable amount of "round-celled infiltration." If this medullary infiltration, as it is called, above described, does not resolve, the affected area is thrown off into the lumen of the bowel by a process of coagulation necrosis. This process is aided partly by the mechanical ischæmia produced by the choking of the vascular channels, and partly by the direct action of the typhoid toxines. These

[1] Quoted in Thatcher's article on "Typhoid Fever," in the Twentieth Century Practice of Medicine, 1899. vol. xvi. p. 586, New York.

toxines, spoken of rather vaguely in the past, have taken on a new significance from recent studies[1] which apparently show that they are the agents producing the agglutination thrombosis of the erythrocytes in typhoid fever. This thrombosis, as well as the ordinary form of thrombosis (produced when the engorged endothelial cells degenerate and induce a precipitation of fibrin—a coagulation necrosis), predisposes to the sloughing, which is either molecular or massive. The surface left by the slough forms the ordinary typhoid ulcer, the floor of which, in the large majority of cases, is formed by the muscularis mucosæ.

Now, if this medullary infiltration has involved the whole thickness of the intestinal wall, when the slough is cast, naturally, a perforation of the bowel results. Accordingly, we find that perforations occurring at this stage of the disease are rarely of the pin-point size so frequently observed at a later date. The reports we have examined are not, most of them, circumstantial enough to enable us to derive any authoritative statistics with regard to the relation of the size of the lesion to the stage of the disease at which perforation occurred; but there can be little doubt that, as a rule, the large perforations occur early in the course of the fever.

If, on the other hand, the slough cast off is slight in depth, the resulting ulcer usually heals. The sloughs are usually separated about the end of the second or the beginning of the third week.

Where the ulcer fails to heal and gradually deepens, as it approaches the peritoneal coat a slight degree of plastic peritonitis may be set up; the serous coat becomes congested, slight effusion ensues, a patch of lymph is formed on the serous surface, and, in favorable cases, the bowel becomes attached to a neighboring coil or to some part of the parietal peritoneum. This is Nature's method of healing a perforation. A specimen illustrating this process is in the Museum of the Pennsylvania Hospital. A tag of omentum has, in some cases, been found at operation attached feebly to the perforated area.

If the process be not arrested at this point, an abscess will form;

[1] Flexner, American Journal of the Medical Sciences, August, 1903; Yates, American Medicine, May 2, 1903.

and cases have been reported in which such an abscess was not opened for two or three months subsequently, the patients ultimately recovering.[1] If, however, no adhesions form, then perforation into the free peritoneal cavity takes place, and general peritonitis results. Even in cases of perforation arising after this manner, the size of the bowel opening may be great, or several small perforations may form in the floor of the same ulcer. At times it almost seems as if the stage of medullary infiltration persisted throughout the disease, since in cases of perforation from ulceration the surrounding parts of the perforated Peyer's patch sometimes are so thickened and friable that it becomes impossible to make sutures hold; whereas at other times the bowel has become so thinned by extensive ulcers that it appears like paper. At times, too, it is impossible to tell whether the perforation has arisen from sloughing or from progressive ulceration.

Much has been written about a pre-perforative stage; and there can be no question but that there is always a time previous to perforation, but we very much doubt whether it can be recognized as a pathological any more than as a clinical entity; because so often there may be a certain degree (and at times a very marked one, too) of peritonitis without any macroscopic evidence of perforation.

As to the form of the perforation, the larger circular lesions are, as has been stated above, generally due to sloughing; the smaller, or cribriform, to ulceration; and the oblong, slit-like perforations have been thought to be due to traumatism.

The perforation is usually situated on the part of the bowel diametrically opposite to the mesenteric attachment, where the lymph glands of the intestine are found and where the blood supply is poorest. Occasionally, however, an ulcer will perforate between the layers of the mesentery, and a retroperitoneal abscess will be formed. Such a lesion may be mistaken for a suppurating mesenteric gland.

The perforation is fortunately single, as a rule; in 271 cases in which this point is mentioned, a single perforation occurred in 236,

[1] T. K. Holmes, Journal of the American Medical Association, March 14, 1903.

while in the remaining 35 it was multiple. In 72 cases the perforation was less than one-eighth of an inch in diameter—practically pin-head in size; in 73 cases it was under one-half an inch; and in only 23 cases was it over a half-inch in diameter—there being only 168 cases in which the size of the perforation was mentioned.

The site is mentioned in 190 cases, and in 140, or over 73 per cent., of these the lesion was found within twelve inches of the cæcum; and in only 4 cases, or 2.1 per cent., was it more than three feet distant from the ileocæcal valve. In 7 cases only was the colon perforated, five times the ascending colon, once each the transverse colon and the sigmoid flexure. Meckel's diverticulum was perforated three times, and the appendix eight times. It is to be noted that we have carefully excluded from this series every case of perforated appendix in which the lesion has not undoubtedly been proved to be of typhoid origin, even rejecting, as of doubtful value, some such cases previously accepted by other authors. There were twelve patients in whom a subsequent perforation occurred. These all died. In three cases, while one or more perforations were found at operation, yet others in the same patients were not detected —these all likewise perished.

At times the perforation is only to be seen after a patch of lymph has been removed from the bowel, the perforation then appearing as a dark spot in the centre of an intensely congested area, at times nearly sphacelated and falling away beneath the fingers.

There was not a sufficient number of cases reported in detail to enable us to determine in what proportion or after what lapse of time adhesions would be found; but, generally speaking, it may be said that adhesions are the exception, that they are usually indicative of a mixed infection, and that, except in cases of several days' standing, they are of unfavorable prognostic import. With regard to the bacteriology, it has been found that in cases where the typhoid bacillus alone is the infecting cause, the usual lesions are a low-grade peritonitis, frequently lemon-colored exudation, few adhesions, and not much lymph. Where the streptococci or the staphylococci abound the lymph is more abundant, and adhesions are the rule if the peritonitis has lasted more than a few hours. The

prognosis is much more grave in the streptococcic infection than in the typhoid. An interesting case in this connection was observed at the Johns Hopkins Hospital. At the first operation on a patient suffering from typhoid perforation bacteriological examination of the peritoneum showed no organisms, while the intestinal contents contained streptococci in abundance; this patient was later subjected to a second laparotomy, at which time the peritoneum was found to be infected by the streptococci, and death soon followed from the peritonitis.[1] Evidently in this case the time which elapsed between the initial symptoms of perforation and the operation—five and a half hours—was not sufficient to infect the peritoneum extensively with intestinal contents; whereas forty-three hours later, when the second operation was performed, general purulent peritonitis was well advanced.

Symptoms.

In what may be called a typical case, the symptoms are well marked and easily distinguished; but, unfortunately, such a case is the exception. It is well known, moreover, both that a patient who has presented all the clinical evidences of a perforation may submit to laparotomy, and no perforation nor even a trace of peritonitis be found; and that, on the other hand, patients may die without any abdominal symptoms of importance, and at autopsy a perforation may be found, to everyone's complete surprise.

But there are undoubtedly certain symptoms which should at once throw the attending physician on his guard, and which should make him disposed to consult one with surgical acumen, even before he is sure a perforation exists. A patient in the second or third week of the disease, who at various times has had slight or more severe stabbing pains in the abdomen; whose abdomen is much distended and tympanitic; who, perhaps, is somewhat apathetic; who is apt to have retention of urine, and has perhaps lost control of his fæcal evacuations—such a patient should be watched hourly. Any one of these slight stabbing pains may be significant of perforation, and

[1] Philadelphia Medical Journal, March 3, 1900, p. 505.

although pain alone is by no means pathognomonic, it is by all means the most valuable subjective symptom.

Pain. The pain is, as described, usually a stabbing sensation, most frequently in the right lower quadrant of the abdomen; though for it to be felt in the epigastric or the umbilical regions is also customary, and a not unusual situation is in the bladder, or, in the male, at the end of the penis.[1] Cases have occurred in which, on such complaint from a ward patient, the orderly has been allowed to use the catheter, drawing perhaps a couple of ounces of urine; and the patient, not again complaining, has been neglected, until in a few hours a fatal peritonitis has developed. But the pain may not cease so readily, and the patients at times will scream out and roll around the bed in an agony, doubling themselves up with abdominal pain, which may persist for two or three hours with undiminished intensity. Again, as has been mentioned, in a very apathetic patient no pain at all may be felt, or, at least, none be complained of. Or, on the contrary, there may be only a gradually increasing discomfort in the abdomen, with no sudden sharp onset of pain. This is more usual where the abdomen is already tympanitic and where peristalsis has been for some time very slight.

Vomiting occurs so frequently in severe cases of typhoid fever with no apparent exciting cause that it cannot alone be considered at all indicative of perforation; but where it occurs for the first time, and especially where it either precedes or follows pain, it should not be passed lightly by. If it is at all violent it will very likely cause a perforation, and in very many instances follows it.

Temperature, etc. At the same time as the pain, or soon after, sweating may occur; it has even been known to precede the pain, which has always been supposed to be indicative of the moment of perforation. With the sweat, or when sweating is absent, occurs a fall of temperature: a drop of four to six degrees is not infrequent. It has been claimed that this fall of temperature—this *hypothermie*—is not at all constant; and the dictum of Dieulafoy,

[1] Philadelphia Medical Journal, May 2, 1903.

"No perforation without fall of temperature," has been called in question by some authors, notably by his countryman, Lereboullet, who maintains, on the contrary, that a rise of temperature invariably follows perforation. Hagopoff tries to reconcile these statements by claiming, and, we think, not without reason on his side, that where no "hypothermie" has been observed it is simply because the temperature was not taken sufficiently soon after the perforation occurred, but at a time later, when the temperature of the patient had risen as a result of the subsequent peritonitis; this explanation really upholding the views of Dieulafoy. Lereboullet's contention certainly cannot be true in all cases, since sometimes the patient is so collapsed as a result of the perforation that the ensuing peritonitis, even if he live long enough for it to commence, is not sufficient to raise his temperature to the normal, but he dies in collapse.

Very confusing in this connection are those cases in which several falls of temperature have occurred within a day or so of the suspected perforation. Fall of temperature is, of course, a frequent accompaniment of intestinal hemorrhage during typhoid fever; and, either as a result of that, or even with no ascertainable cause, the patient may, for several days, perhaps merely from general loss of vascular tone, have suffered at irregular intervals from sweats and sudden falls of temperature. So that neither of these symptoms, any more than abdominal pain, is to be regarded as pathognomonic of perforation.

Frequently a change in the solubility of the *bowels* follows perforation. Were they loose before, they become confined; or were they costive previously, this condition is replaced by diarrhœa.

Delirium may have pre-existed, or may develop only with the peritonitis.

Leaving now the subjective symptoms, we come to the physical signs, on which more reliance is to be placed; and of these by all means the most valuable is rigidity of the abdominal walls.

Rigidity. By this we mean, not that rigidity which the physician may any day produce by thrusting his fingers into the patient's belly so as to feel the backbone, but the well-known rigidity ensuing on peritoneal inflammation, and which is involuntary, reflex, not

produced by palpation. This muscular rigidity is most frequently observed in the right rectus muscle; also in the right oblique muscles and in the left rectus; in time spreading with the peritoneal inflammation all over the abdomen. A surgeon's rigidity and a physician's rigidity are two vastly different things, and the distinction is well worth remembering. The rigidity of pleural irritation is sometimes mistaken for peritoneal involvement, or *vice versa*. In one of our own cases operation was delayed because of evidences of a pulmonary lesion, whereas perforation was really present, as was sadly manifested by the peritonitis which developed a few hours later, and the operation performed then was too late.

Pulse and Respiration. Along with these cardinal symptoms—pain and rigidity—there is, in the vast majority of cases, an increase in the pulse rate. In most cases of typhoid fever the pulse is slow in relation to the height of the fever, rarely averaging more than one hundred beats per minute; but after perforation the rate rises to one hundred and twenty or one hundred and forty in a very short time, often within fifteen or twenty minutes; and the respirations may be accelerated as well. Not until peritonitis is well advanced does purely costal breathing replace the costo-abdominal, which is the normal; and patients who are at all conscious alter the character of their respirations so readily during examination that too much reliance should not be placed on this sign.

The facial expression is important. Almost from the very moment of perforation there is a distinct change of expression, difficult to describe, yet easily recognized when once seen. It is not the peritonitic facies, which closely approaches the Hippocratic in type, but is distinctly characteristic of the shock of perforation. It is what the French might call an "abattement" of the countenance, consisting in a general weakening of the expression.

Tenderness, while often present throughout the disease, is probably, without exception, increased by a perforation. In appendicitis it may persist when, the appendix having become gangrenous, rigidity has disappeared; but we are of the opinion that in intestinal perforation rigidity is the more valuable sign of the two; for, as has been mentioned above, in the apathetic state to which

typhoid patients often attain, tenderness sometimes cannot be elicited. When present it is usually found in the right lower quadrant, near the customary site of the lesion.

Dulness to percussion is a very uncertain sign. It may exist from a fæcal accumulation, and be mistaken for the matting together of intestines from peritoneal inflammation. Even movable dulness in the flanks may be caused by fluid fæces within the intestinal tract, when there is no suspicion of perforation. But if well-marked movable dulness in the flanks develops in the course of an hour, as we have seen it do, it presents very excellent evidence of a solution of continuity in the intestinal walls, as it is scarcely conceivable either that fluid fæces within the bowels should at one time produce no such signs, yet within an hour later do so; or that an amount of exudation sufficient to give movable dulness could be formed by the peritoneum in so short a space of time. But, on the other hand, the absence of this free peritoneal fluid should, on no account, be taken as showing that neither perforation nor peritonitis existed.

The same remarks apply to obliteration of the liver dulness as to movable dulness in the flanks; it may occur merely from tympany, without perforation, and even with perforation and with air free in the peritoneal cavity, the dulness over the liver may persist. However, they are both interesting signs, and it is well to note their presence or absence.

Œdema of the abdominal walls is occasionally observed in this, as in other intra-abdominal lesions, but has no specific significance.

Blood. The condition of the blood is one of the most vexed questions that arises in this connection. It has been much more extensively studied by American than by English or Continental observers. Osler says that a steadily rising leucocyte count is indicative of perforation; for such an observation the white blood cells should be counted every half-hour or hour during the period of uncertainty. Few hospitals, and no one in private practice, can afford to have this done, even the routine work in most institutions consuming the whole time of the clinical pathologist. In most cases where, in the course of twelve or eighteen hours, three or four examinations at the outside are made, the majority of advocates of

the benefits conferred by blood examination claim that such erratic observations are of no use. The average surgeon is averse to having his diagnosis made for him in the laboratory, and will not hesitate to follow his own judgment, in the face of overwhelming contraindications from the microscopist's standpoint.

A wave of leucocytosis has been described, reaching its maximum soon after perforation, and then again subsiding. Differential counts have been claimed to be more reliable than a mere enumeration of the white cells as a whole, inasmuch as in commencing peritonitis there is a disproportionate increase in the polynuclear neutrophiles.

In drawing conclusions from any leucocyte count in typhoid fever, the normal leucopenia of this disease should be borne in mind.

This whole question is as yet undecided, the accurate observations being still too few to draw any very definite conclusions.

Differential Diagnosis.

A differential diagnosis has most often to be made from hemorrhage. While the collapse is very likely the same in either case, yet hemorrhage is, as a rule, not attended by pain, and there is no rigidity present; in hemorrhage the blood is generally passed by the bowel in the course of an hour or so at the outside; and in most cases where confusion is liable to arise, the occurrence of previous hemorrhages in the same patient would incline one to pause before undertaking an exploratory laparotomy. Osler and others have reported series of cases in which attention is called to the frequent association of hemorrhage with perforation; and in any case where reaction from the collapse, due to an obscure abdominal lesion, does not occur promptly, we are in favor of operative treatment, since in one of our own cases the bleeding point has been found by laparotomy and ligated.

The diagnosis from peritonitis without perforation is immaterial, as operation is indicated in both conditions.

From appendicitis the diagnosis can best be made by recollecting that in appendicitis there is rarely such collapse as occurs from

perforation of the small or large intestine, even if the appendix be perforated. Vomiting is more apt to have occurred with the initial pain in appendicitis than in perforation. Moreover, vomiting may cause perforation, while it could scarcely alone produce appendicitis. Symptoms resembling those of appendicitis are not unusual at the beginning of an attack of typhoid fever, and in a number of cases the appendix has been removed under such circumstances with happy results. The differential diagnosis here too is not especially important, as the removal of the appendix for disease is indicated in typhoid fever as well as at any other time.

From peritonitis due to pelvic or ovarian disease the diagnosis can usually be satisfactorily made by attention to the history of the case, together with a vaginal examination.

We have seen intussusception occurring during an attack of ambulatory typhoid fever, but as the peritonitis was already well advanced, no question of differential diagnosis arose.

Affections of the gall-bladder occurring during typhoid fever from infection by the typhoid bacillus are not uncommon; they present pain in the right hypochondriac region; sometimes jaundice; vomiting is more persistent; no fall of temperature occurs; there is little shock; and the physical signs—tenderness, rigidity, dulness, palpable mass—aid in the localization of the disease.

Gastric ulcers may perforate during typhoid fever: the localizing signs here, too, are our chief guide.

Finally, suppurating mesenteric glands, or splenic infarcts, may give rise to peritonitis in this disease; but here the symptoms are those of peritonitis pure and simple; there are none of those characteristic of intestinal perforation.

Prognosis.

It may be confidently said that of those patients who die after an operation, in very few, indeed, has the operation hastened death. Even in those cases which end unfavorably, it is usually observed that the patients have left the operating-table in better shape than that in which they were brought to it: so much is gained by intravenous saline injections, by vigorous hypodermatic stimula-

tion, and frequently by the free douching of the abdominal cavity with hot saline solutions.

Only five of the patients operated on are known to have died before the conclusion of the operation. Of those that died, twenty-one lived two days, twenty-three lived three days, twenty-one lived five days, seven lived nearly a week, while eleven lived over a week, three over two weeks, and four over a month; certainly in these last eighteen cases the patients may be said to have recovered from the operation.

Of the whole number, 26 per cent. finally left the surgeon's hands well. A small proportion of these, to be sure, might look forward to an intestinal obstruction arising at any time of indiscretion in diet, if they had been the subjects of extensive peritoneal adhesions; some, furthermore, when last reported had still a fæcal fistula in the wound; and probably a considerably larger number had or would soon develop a ventral hernia; but taking them all in all, they had reason to be thankful to have escaped a typhoid perforation with their lives.

The extensive analytical tables attached show in compact form the mortality rate considered from very various points of view. Briefly stated here, the most favorable cases have been those in girls from ten to fifteen years of age, the perforation occurring in the first week of the disease, when the constitution is still strong, or in convalescence, when the frame is already re-established; who have been operated on in the third hour after perforation, the single perforation being pin-head in size (under one-eighth of an inch in diameter), within a few inches of the cæcum, or in the appendix; and where neither fæcal extravasation had occurred, nor adhesions were present. Such would be ideal cases, and the mortality should be less than 50 per cent.

Treatment.

The treatment of all patients suffering from intestinal perforation in typhoid fever should be by laparotomy and suture of the perforation; to trust to medical treatment alone is nothing short of folly. Some cases may be thought an exception to this

rule: those patients who are manifestly moribund should be given the benefit of doubt, and if, under vigorous stimulation, any improvement is noted, or even if they cease to grow worse, the surgeon should not hesitate to interfere. The average time consumed in the operation by skilful operators is about fifteen or twenty minutes. Nor should it be forgotten that ether is a heart stimulant, and if the pulse improves under its administration operation is surely justified. We believe that well-authenticated cases of recovery from intestinal perforation without operation are excessively rare; indeed, since it has happened with every symptom of perforation present, and the abdominal cavity having been opened and explored, that no signs of perforation, much less of peritonitis, have been found, it may be considered proved that the examples of so-called recovery from perforation without operation are cases of this nature, and that while the symptoms of perforation and of peritonitis may have been present, yet such lesions did not exist. Even in cases, almost unknown as they are, where the patients have survived the immediate effects of the perforative peritonitis, yet, even many months subsequently, they have submitted to laparotomy for an abdominal abscess of apparently obscure origin, but evidently arising from the former peritonitis —the condition being, in fact, one of residual abscess. Hagopoff, seemingly a careful observer, accepted as genuine instances of recovery without operation only fourteen cases, rejecting those observed by Griesinger, which are recorded in the thesis of Morin. When it is recollected that, according to the calculations of Briggs,[1] more than 16,000 perforations of the intestine due to typhoid fever occur annually in the United States alone, the exceeding rarity of recovery without operation is appreciated by realization of the fact that for all time, and all over the world, only fourteen cases are known which have so terminated.

From the moment of diagnosis until the time of the operation little is to be done in the way of treatment, except by stimulation, hypodermatically, or with intravenous saline injections. To avoid the

[1] American Journal of the Medical Sciences, May, 1903.

delay sometimes occasioned to obtain consent of the family to an operation, it is well to arrange such questions, in every possible case threatening perforation, even before the diagnosis is made: the less time that elapses between diagnosis and operation, the better for the patient.

Anæsthetic. As to the danger of a general anæsthetic in such patients as these, we believe that while some operators may have the faculty of so hypnotizing their patients as to make local anæsthesia available, yet the average surgeon will succeed better by the use of ether judiciously administered. In other climates, and in higher altitudes, we have no doubt that with care chloroform can be safely employed, but certainly in the middle and northern parts of the United States nothing is so satisfactory as ether. We are, moreover, of the opinion that a general anæsthetic will, in the average patient, tend to diminish shock, although we freely admit that the abolition of all afferent impulses produced by the cocainization of sensory nerves will theoretically render impossible the physical conditions now believed to be necessary for the production of surgical shock. But mental perturbation is at least an equally disquieting element for the surgeon to deal with, and this is in no respect diminished, but rather augmented by the consciousness on the patient's part of the details of the surgical procedures.

Most of the patients with perforation seen by us have been already in such a state of prostration that only a few whiffs of the anæsthetic have been required to completely anæsthetize them, as well as to render them unconscious and to relax their abdominal muscles, a state which is not attained by the use of a purely local anæsthetic.

In the majority of cases where the operation has been commenced with a local anæsthetic, it has been found expedient to resort to the use of ether or chloroform soon after opening the peritoneal cavity, and often fifteen or twenty minutes have been consumed in making the incision through the abdominal parietes alone, the patient meanwhile complaining bitterly. This state of affairs, we should add, has not always been the case, for some surgeons have had most gratifying results from local anæsthesia in operations of this kind.

When anæsthetization is begun (and this should not commonly be done until the patient is on the operating-table), the abdomen should be shaved, including the pubic hair, and cleansed. We prefer for this purpose turpentine, followed by green soap and water and then by alcohol; the whole area is then thoroughly rinsed off with corrosive sublimate (1 : 2000) and covered with a cloth wrung out of this solution until the surgeon, who has meantime been cleansing his hands, is ready to operate. The three processes—anæsthetization, cleansing of the abdomen, and washing of the surgeon's hands—are commonly completed at about the same time, so that everything is coincidently ready for operation. It is convenient for the surgeon to have two assistants, as well as three nurses at his service: one nurse to hand instruments, thread needles, etc.; a second to attend to the gauze sponges; and a third to bring hot salt solution, etc., as wanted. There should, likewise, be a fourth nurse at the call of the anæsthetizer to administer hypodermatic injections, tend the oxygen apparatus, and similar duties. Where facilities abound a third assistant for the surgeon, and a fifth nurse can frequently be advantageously employed in giving an intravenous injection of hot normal salt solution; seldom more than three pints are necessary, often two is an abundant quantity. By recommending all this array of assistants as convenient, we do not by any means wish to be thought to discountenance impromptu surgery where necessary in these cases. There have been brilliant successes reported from operations done by lamplight on a kitchen table, in huts miles away from city hospitals; and such records are among the proudest in surgery; but wherever possible it is the operator's duty to organize success.

The cleansing of the abdomen, while thorough, should not be vigorous, both for fear of diffusing any extravasated fæcal matter and of producing further perforations.

From the time the knife is first taken in hand things should move with rapidity—this is only possible by system and regularity. We know of no other condition, except it be, perhaps, hemorrhage, in which speed in operation is so imperative. In too many instances it is a race with death, and there are often anxious moments when

it is questionable who will win; yet in only five of the reported cases is death known to have occurred before the operation was completed. A "death on the table" is, under all circumstances, a most painful occurrence in surgery, but it is doubly so if the surgeon has in any way to blame himself for delays that might have been obviated by a prudent mind.

The incision is best made to the right of the median line, over the cæcal region. Many of the earlier operators employed a median incision, in most instances hypogastric, but in not a few epigastric; their results, however, and especially so with the epigastric incision, do not invite imitation. In 96 cases where a median hypogastric incision was employed the mortality was over 78 per cent., while in 141 cases where the right lateral incision was used the mortality was less than 70 per cent. Of course, were an abscess to be manifestly pointing in a certain region it would be absurd to open the abdomen elsewhere. Where the median incision has been employed it has only too often happened that the surgeon has searched the presenting small intestine diligently without finding a perforation, until he has unexpectedly lighted on the duodenum, and has then been forced to retrace his steps downward to the cæcum, thus losing valuable time, and shocking his patient by prolonged manipulation of the bowels.

The length of the incision need not in abdomens of average thickness exceed four inches, as a rule; in uncomplicated cases three inches can be made to suffice; while in those patients with immensely fat abdominal walls the incision may, unfortunately, have to be extended nearly to the edge of the ribs upward and to the symphysis below. It is, on the other hand, by no means wise to endeavor too much through too small an opening; much harm may occur from blindly tugging at a coil of intestine which fails to come out through a wound, not because the latter is too small for such delivery to be physically possible, but because the bowel is retained by adhesions the incautious rupture of which may cause much mischief.

The incision we prefer is that through the outer half of the right rectus muscle: it is straight, simple, direct, and economical of time:

the deep epigastric artery is not apt to be wounded with ordinary care, using the handle rather than the blade of the scalpel to separate the muscular fibres; it is a route that gives direct access to our landmark, the cæcum, and to that part of the small gut most often affected; it affords quite sufficient room for exploring nearly the whole abdomen; it can be extended in either direction at need, and offers excellent drainage facilities. In those very rare cases where the perforation is in the sigmoid or in those parts of the small intestine not in reach of this wound, this incision should be temporarily closed, and another made where, from intra-abdominal exploration, it is evident that it would be nearest the seat of the trouble.

When the peritoneal cavity is opened the cæcum should be located; it is usually immediately beneath the wound or a little to the outer side. The vermiform appendix should be inspected and removed, if necessary. If extravasation is free no packs are required. If, however, it appears that the peritonitis is fairly well localized the affected area should be walled off with large gauze pads. The ileum is next drawn into the wound and carefully examined; it is a great advantage to have two pairs of eyes examining it at the same time, as it passes through the surgeon's hands, one watching the upper and one the lower surface. It is usually inadvisable to replace the gut at once on withdrawal, as this consumes valuable time, which is better spent searching for the perforation until found. If, however, more than two or three feet of the ileum have been examined fruitlessly, and there still appears to be reason to consider a perforation present, the eventrated parts should be re-examined, commencing at the highest point withdrawn, and ending at the cæcum, the coils being replaced as the return is made, but the highest coil being kept out of the belly until all the others have been replaced, as a starting point for further search, which should proceed upward along the ileum with like manœuvres until there appears no further prospect of finding a perforation. This probability decreases as the area of greatest inflammation is left behind. The appearance the perforation will present can often be fairly accurately foretold by attention to the known pathology of the disease: if fæcal extravasation is free a medium or large-sized

hole may be expected; if lymph abounds and clings to the bowel in patches, frequently beneath one of these patches will be found the pin-head lesion as a dark spot in the middle of an intensely congested Peyerian gland.

Throughout these manipulations the utmost care should, of course, be exercised to prevent chilling of the eventrated bowels. This is best secured by covering them with a hot towel, and constantly douching it and the bowels with hot saline solution; this aids, too, in washing away pus, etc. It should be seen, also, that the patient is not thus made to lie in a pool of rapidly cooling water; he should be so protected by blankets, mackintosh cloths, etc., as to maintain his bodily warmth, and, if necessary, he may even be surrounded by hot-water cans during the entire operation. If adhesions are present the operation is much more tedious and difficult; but fortunately they are rare.

Suture. When the perforation is found all other coils of intestine should be replaced, and it should be sutured. But if the bowel is much distended with gas or fæcal matter, it is well to allow it to discharge itself through the perforation outside the abdomen. Indeed, puncture of the bowels for this purpose has been employed to facilitate eventration, but we have never found it necessary to do this, although, to aid their reposition, it is sometimes nearly imperative. Any such puncture is easily closed with a couple of Lembert sutures.

Excision of the ulcer we deem not only perfectly useless, but harmful as well, since it consumes unnecessary time and might open a bloodvessel.

Black silk we think the best material for the intestinal suture, using it threaded on a round straight needle. Such a needle is more easily controlled by the fingers, and, when time is such an important element, such devices as needle-holders may well be dispensed with. Usually we prefer to apply first a row of mattress sutures parallel to the long axis of the gut, crossing the longitudinal Peyer's patch at right angles. A second row of Lembert sutures, likewise applied longitudinally, but continuous, is also employed; and in the vast majority of cases these two tiers are quite sufficient to occlude

the perforation satisfactorily. At times it may be more expedient to use a purse-string suture, the application of which takes less time, and which holds well if the perforation is small and the surrounding bowel in fairly good condition. We seldom rely on Lembert sutures alone, even in several superimposed rows. We avoid, where possible, a line of suture transverse to the long axis of the gut, believing that the tension on the stitches is thus greater and that the lumen of the bowel is usually more impaired. It is unusual to find the diseased area extending as far transversely as it does longitudinally, but where this is the case in such a degree as to make suture impossible, or from other cause, the grafting of a piece of omentum over the defect, enterectomy, with end-to-end anastomosis, or simply the establishment of a false anus, must be considered. The choice depends largely upon the general condition of the patient, the skill of the surgeon, the location of the perforation, and the state of the peritoneal cavity. To make a false anus consumes less time and is easier of operation to one unaccustomed to abdominal surgery. It may even be done without suture by the judicious use of gauze packs, leaving the perforation isolated and beneath the abdominal wound. Of four cases treated by the establishment of a fæcal fistula, every one died. This tremendous mortality, however, does not prove that the operation is necessarily fatal in cases of typhoid perforation, but merely that it has been employed only in exceedingly ill patients. On the other hand, of those sixteen patients who withstood the immediate shock of the perforation, and in whom a fæcal fistula developed in the wound after operation, only two died—the surprisingly low mortality of 12.5 per cent. This shows that direct drainage of the intestinal tract is actually beneficial. In this connection it is interesting to recall the treatment by the establishment of a false anus advised by some authorities in cases of colitis, and even in typhoid fever, as a means of drainage and irrigation of the large bowel.

But the establishment of a fæcal fistula is sure to prolong the healing of the wound, and, in a fair proportion of cases, will require a subsequent operation for its closure. In those exceptional cases where the lesions are high in the intestinal tract it is, of course, not

to be considered, on account of the well-recognized danger of starving the patient by short-circuiting his ingested food. Moreover, it is difficult to drain the peritoneal cavity effectually through the same wound at which the bowels are emptying themselves, and there is the constant risk of reinfecting the peritoneum by leakage backward. So that, on the whole, where inversion of the perforation by suture, or omental grafting is impossible, excision of the diseased portion of the gut, with circular enterorrhaphy, is by all means to be preferred. But this should not be lightly undertaken; for while cases have been recorded where the narrowed lumen of the bowel, due to inversion of the perforation, has been held responsible for death from intestinal obstruction, yet we believe that this complication is not to be apprehended, except where practically no lumen at all exists: the fæces in the ileum are usually fluid, and there is no reason to expect that a stricture thus formed may not dilate sufficiently in the natural course of events to cause no further trouble.

Circular enterorrhaphy may be performed satisfactorily here without mechanical appliance; those who prefer such devices may employ the O'Hara or the Laplace forceps, and the Murphy button may be used without fear of evil consequences. It has been thought that this last would be liable to cause a new perforation while passing out, or would pull loose from the friable intestinal walls by its own weight; but we do not think these accidents more liable to occur in typhoid fever than in other cases. Intestinal resection was employed five times in our series of cases, with only one recovery. The Russian surgeons have been its chief advocates, but it is apparently too severe an operation to be usually recommended.

Omental grafting is applicable as well to ulcers threatening perforation as to actual perforations. The omentum is to be adjusted over the defect and retained in position by points of the interrupted suture. In some cases the omentum has been found already covering in the perforation and preventing fæcal extravasation. Grafting the omentum in place is in every way preferable to either establishing a false anus or to enterectomy.

In selecting the special method of operation time should not be unnecessarily wasted; every surgeon knows that it is better to do

the second-best thing for his patient than to let him die while a decision is being reached.

Every perforation having been found and treated as seems indicated, the *toilet of the abdominal cavity* should next claim the surgeon's attention. While he retains the sutured gut beneath the wound he should, in our judgment, if there has been fæcal extravasation or if there is general peritonitis, resort to free douching of the abdominal cavity. And in doing this he should remember that the perforation is now practically out of the question, and that his only hope in saving the patient lies in combating the peritonitis. To this end a large tube, one-half inch in diameter, with multiple perforations, should be introduced through the wound, a rubber tube and a funnel being attached to its outer end, and through this should be poured gallons of hot solution. We are of the opinion that the quantity has more to do with success than the quality of the fluid used, although our own practice is to use normal salt solution in ordinary cases, and in cases with much pus, streptococcic in origin, we use first the normal salt, then equal parts of normal salt and hydrogen peroxide, and, finally, normal salt again —several quarts of each solution being employed. The temperature of these solutions should be at least 110° F., and to ensure its reaching the abdomen not below this temperature, it is well for the thermometer in the receptacle from which the supply is drawn to stand at not less than 115° F. The tube through which this douching is carried out should first be applied to the pelvis, in the rectovesical space, and in females both in front of and behind the broad ligaments; it should then be carried to the left flank and loin, up even to the spleen; the right side should be similarly treated, and the spaces between the intestinal coils should finally be visited. The douching should be continued until the return fluid is clear. Some surgeons have advocated first sitting the patient up to allow all matter to drain into the pelvis, and when that had been accomplished, reversing the body into the Trendelenburg position, and then mopping out the pelvic cavity with gauze. A patient treated by these heroic manipulations recovered.

When the surgeon is satisfied that the abdominal cavity is as

clean as he can make it by this method, but not before, the tube may be withdrawn, but the main part of the fluid that has not already escaped, and which is clean, should be allowed to remain.

Several of the earlier operators used carbolic acid or boric acid solutions for this douching; and, as we said before, we do not think the composition is of any particular moment, the cleansing being largely mechanical. Some of the later surgeons, notably those at the Johns Hopkins Hospital, have, under local anæsthesia, prolonged this douching for upward of an hour, but we do not think much is gained by such a course. It is, however, unquestionable that very many patients show very marked constitutional improvement from the abdominal douching; the heat combats the shock, and the fluid is constantly absorbed, thus taking the place of or aiding an intravenous saline injection.

Many authorities are unalterably opposed to douching the abdomen at all in these cases, asserting that the infectious particles are only more widely diffused, and relying entirely on dry sponging and rubbing off of lymph patches, etc. While we have no desire to deny that these methods have in some instances been followed by the happiest results, and while we have ourselves treated cases without douching of any kind, yet we remain firm in our belief that by douching in the manner above described lies the surgeon's greatest hope of success. Moreover, we recollect that long ago Sir James Paget contended that "wounds," and, we may add, *a fortiori*, the peritoneum, "should not be scrubbed, even with sponges."

In the appendix will be found an analysis of those cases where the description of the operation was sufficiently minute to enable us to abstract the treatment in regard to irrigation, wiping, drainage, etc. It is to be regretted that most reports are so vague in these particulars as to be not adapted for such purposes. Those cases marked "wiping and drainage," with a mortality of 61 per cent., were mostly cases of purely localized peritoneal lesions, as were also those where neither irrigation nor drainage were employed, with a mortality of only 41 per cent.; so the success here was only relative, and does not show that these methods are the best for all cases.

Drainage. Drainage is necessary in nearly every case. We now prefer gauze drains to the tube we formerly employed. The amount and the extent of the drains to be inserted will, of course, depend on the extent of the peritonitis. In the simplest cases a wick of gauze alone may be placed to the site of the sutures in the intestine, and the abdominal wound closed through nearly its entire length. If, however, there be any suspicion of pelvic involvement a good-sized strip of gauze should be carried down to the pelvic floor. We commonly employ pads of sterile gauze, about six by eighteen inches in size, composed of four thicknesses, stitched together; or loose, crumpled gauze answers equally well, although not so handy. We see no advantage in iodoform or other medicated gauze in these cases, and never employ it. Some instances of poisoning from iodoform gauze indiscriminately used in abdominal surgery are within our cognizance, and the possibility of such an event alone is enough to deter one from its use. In cases of widespread peritonitis a second piece of gauze to the left flank, a third to the right, outside the descending and the ascending colon, respectively; a fourth above the ileum and to the inner side of the ascending colon, are advisable, and several more as may be required to hold the small intestines away from the pelvis and the site of operation. We have seldom had to use more than seven such packs. The ends projecting from the abdominal wound should be left fairly long, and those going to the pelvis or to the intestinal sutures should be indicated by a knot or a safety-pin, so as to avoid confusion later.

If the abdominal wound be very large a suture or two may be applied at each end to somewhat diminish its size and to obviate the protrusion through the unhealed wound of a knuckle of gut, although this last complication has in no way interfered with recovery in the cases where it has occurred.

The dressing should be copious. Crumpled gauze should be applied next the wound in abundance, and over this many layers of flat gauze, the whole being retained in place by a bandage of Scultetus.

The patient is to be speedily returned to a well-warmed bed, not in the general ward, and be allowed to retain the same bed until

fairly convalescent. The frequent moving of such patients is extremely undesirable. The foot of the bed may be raised twelve or eighteen inches, and the fluid will thus readily drain out of the pelvis. Some surgeons prefer Fowler's position, with the head of the bed raised, so as to drain into the pelvis; but while good results have been obtained by both methods, the former commends itself to us as aiding in overcoming the shock, as well as making very efficient drainage.

Hypodermoclysis, or intravenous infusion of normal salt solution, may be begun now or continued if not completed as soon as the operation. When the patient comes out of ether a high enema of hot normal salt solution should be given, and may be repeated every two or three hours. It both allays the thirst and is a valuable adjunct to the abdominal drainage. A pint is readily absorbed by the colon in a short time.

After-treatment. If the patient reacts from the perforation, he must be nourished, but all food by the mouth is to be avoided as long as possible. Six to eight ounces of milk peptonized for a half-hour, with some prepared beef-juice, may be given by enema every two or three hours, the balance of the pint being of the normal salt solution—fortunately there is no palate in the lower bowel, and such mixtures are well tolerated. Hypodermatic stimulation is indicated as in other cases of similar nature. Hypodermoclysis of normal salt is likewise a valuable adjuvant, and may be repeated in quantities of a pint or two every four or six hours. Indeed, we think that the more fluid that can be absorbed from the lymphatics in these ways—hypodermatically and from the colon—the better it is for the patient; it overcomes the typhoid toxæmia, which is too often the precursor of death, and drains the peritoneal cavity from the mucous lining of the intestines outward. A few hours after the operation the outer dressings will probably be found saturated with the salt solution left in the abdomen at the time of operation, and will require changing. This saturation of the outer dressings may occur every four to six hours at first, being a favorable sign; the gauze packs acting as siphons and draining the peritoneal cavity in a most satisfactory manner.

Ice to the abdomen we regard as harmless, but of doubtful utility.

We have found in analyzing these cases that the greatest number of deaths took place between eight and twelve hours after the operation. Those patients who lived more than twelve hours after the operation have a fair chance of recovery, only 59.8 per cent. of them dying.

After twenty-four hours a teaspoonful of hot water may be given by the mouth every ten or fifteen minutes. Thus taken it is less apt to nauseate, and is probably all absorbed before reaching the stomach. No food should be given by the mouth until the third or fourth day at least, nutritive enemata being meanwhile continued. One or two cleansing enemata of plain water in the twenty-four hours are usually sufficient to remove all fæcal matter. When mouth-feeding is begun it should be borne in mind that the patient has both typhoid fever and a sutured area in his intestine, and he should be fed accordingly. Those cases do best where, the acme of the disease being past, a fairly liberal diet can be allowed early. Those patients, on the other hand, who, although they were in fairly good condition at the time of perforation and so have borne the operation well, but have yet several weeks of fever with which to contend, are very apt to die during the second or third week after the operation.

After the third or fourth day the surgeon should begin to think about removing the gauze drains; but let him be in no hurry about it—far better for them to remain a week or ten days than to be removed too soon. They should be well moistened with salt solution or hydrogen peroxide, and be given time to absorb it, and the utmost gentleness should be used in separating them from the intestines. It should be remembered that in time the peritoneal granulations will push the gauze away as a foreign body, and if the drains cannot be readily withdrawn on the first trial the attempt should be postponed for twelve or twenty-four hours. In drawing on the gauze it is well rather to try to separate the bowel from the gauze than the gauze from the gut. This is most expeditiously done by a sort of blunt dissection with the finger. Blind tugging at the drains is a most harmful as well as painful procedure, and it cannot be too often impressed upon the dresser that the gauze will come away of

itself in time; it is only for the purpose of accelerating the cure and of keeping the wound fresh that nature should be thus assisted.

When the gauze has been removed it requires nice judgment to know how much to replace—this can only be learned by experience; if too much is replaced the healing of the sinus is delayed, and intestinal obstruction may be produced; if too little, a residual abscess may form in some pocket not efficiently drained; or rarely, where the adhesions are firm, intestinal obstruction may ensue from kinks of the bowel occurring from its sudden expansion on the removal of pressure.

A fæcal fistula may be regarded as of good prognostic import as far as life is concerned, as was mentioned before, and it has seldom failed to heal spontaneously, though, of course, delaying ultimate recovery. If it does not heal of itself it is better for the patient to endure the necessary discomfort until he is thoroughly convalescent, as a second laparotomy during typhoid fever is to be avoided if possible. If a second perforation occur, nevertheless, a second laparotomy must be performed and similar treatment instituted. The same remark applies to intestinal obstruction from bands or adhesions. Of eight cases where more than one operation has been performed, no fewer than three patients recovered (62.5 per cent. mortality), and, of these three, two endured three laparotomies.

Exploratory Laparotomies.

Finally, a few words must be said about exploratory operations where the diagnosis is uncertain. Of twenty-six such operations where no peritoneal lesions were found, sixteen eventually recovered; only ten died, a mortality of 38.46 per cent. Of the nine fatal cases in which the duration of life after operation is known, only three died in less than twelve hours. Of these three, one (Finney) died from pulmonary embolism following iliac thrombosis; the second (J. F. Mitchell) had had severe hæmatemesis and enterorrhagia shortly before operation, and was in a very precarious condition; while in the third case (Le Conte), which lived nearly seven hours after operation, the toxæmic state previously

existing persisted without material change until death. In these three cases local anæsthesia was used, and in no way can the exploratory incision be held to have had any connection with the fatal termination.

This "laparotomie blanche," therefore, as it is named by Hagopoff, is practically never a cause of death, and, in our judgment, is to be recommended in all doubtful cases, especially as in some instances the irrigation of the peritoneal cavity employed has actually seemed to exert a beneficial influence on the course of the disease.

Statistical Summary.

Analysis of Whole Number of Cases.

Recovered	94
Died.	268
Total	362
Mortality	74.03 per ct.

Analysis of Cases where Age and Sex are Known.

Age.	Male.			Female.			Total.			Mortality per ct.		
	Recov.	Died.	Total.	Recov.	Died.	Total.	Recov.	Died.	Total.	Male.	Female	Total.
Under 10 yrs.	3	2	5	1	3	4	4	5	9	40.0	75.0	55.5
10–15 "	9	10	19	3	3	6	12	13	25	52.6	50.0	52.0
15–20 "	6	29	35	1	2	3	7	31	38	83.0	66.6	81.8
20–30 "	16	70	86	8	19	27	24	89	113	81.4	70.3	78.0
30–40 "	13	44	57	6	6	12	19	50	69	77.2	50.0	72.4
40–50 "	8	10	18	1	2	3	9	12	21	55.5	66.6	57.1
50–60 "	0	3	3	0	1	1	0	4	4	100.0	100.0	100.0
Total	55	168	223	20	36	56	75	204	279	75.3	64.2	73.1

Analysis of Cases According to Sex Alone.

Sex.	Recovered.	Died.	Total.	Mortality.
Male	61	190	251	75.6 per ct.
Female	22	38	60	63.3 "

Analysis According to Duration of Perforation before Operation.

Cases operated on :	Recovered.	Died.	Total.	Mortality.
First 12 hours after perforation	35	95	130	73.0 per ct.
Second 12 hours after perforation	22	62	84	73.8 "
Third " " "	2	29	31	93.5 "
Over 36 hours " "	18	37	55	67.2 "

Analysis of Cases where Date of Operation is Known.

Year.	Recovered.	Died.	Total.	Mortality.
1884	1	0	1	0.0 per ct.
1885	0	2	2	100.0 "
1886	0	1	1	100.0 "
1887	0	3	3	100.0 "
1888	0	3	3	100.0 "
1889	1	3	4	75.0 "
1890	0	1	1	100.0 "
1891	1	5	6	83.3 "
1892	0	1	1	100.0 "
1893	0	4	4	100.0 "
1894	4	11	15	73.3 "
1895	5	12	17	70 5 "
1896	6	15	21	71.4 "
1897	3	9	12	75.0 "
1898	10	25	35	71.4 "
1899	6	40	46	86.9 "
1900	14	18	32	56.2 "
1901	11	15	26	57.6 "
1902	16	21	37	56.7 "
1903	4	21	25	84.0 "

Analysis According to Lustrums.

Period of time.	Recovered.	Died.	Total.	Mortality.
1884–1888	1	9	10	90.0 per ct.
1889–1893	2	14	16	87.5 "
1894–1898	28	72	100	72.0 "
1899–1903	51	115	166	69.2 "

Stage of Disease in which Perforation Occurred.

Perforation occurring :	Recovered.	Died.	Total.	Mortality.
First week of the disease	4	2	6	33.3 per ct.
Second " "	16	43	59	72.8 "
Third " "	22	81	103	78.6 "
Fourth " "	11	33	44	75.0 "
Fifth " "	5	20	25	80.0 "
Sixth " "	3	3	6	50.0 "
After sixth week of disease	4	12	16	75.0 "
In a relapse	8	7	15	46.6 "
In third relapse	0	1	1	100.0 "
In convalescence	7	4	11	36.6 "

Time Elapsing between Perforation and Operation, in Detail.

Operation performed.	Recovered.	Died.	Total.	Mortality.
Within a half-hour	0	2	2	100.0 per ct.
" one hour	0	2	2	100.0 "
" two hours	2	4	6	66.6 "
" three hours	3	1	4	25.0 "
" four hours	2	12	14	85.7 "
" eight hours	17	39	56	69.6 "
" twelve hours	12	34	46	73.9 "
" eighteen hours	10	32	42	76.1 "
" twenty-four hours	12	30	42	71.4 "
" thirty-six hours	2	29	31	93.5 "
" forty-eight hours	4	16	20	80.0 "
" seventy-two hours	8	10	18	55.5 "
" five days	4	9	13	69.2 "
" two weeks	1	1	2	50.0 "
After two weeks	1	1	2	50.0 "

Analysis as to the Perforation.

	Number of perforation.	Recovered.	Died.	Total.	Mortality.
I.	Single	65	171	236	72.4 per ct.
	Multiple	5	30	35	85.7 "
II.	Size of perforation.				
	Under ⅛ inch	35	37	72	51.3 "
	" ½ "	17	56	73	76.7 "
	Over ½ "	7	16	23	69.5 "
III.	Site of perforation.				
	Within 12 inches of cæcum	32	108	140	77.1 "
	" 24 " "	7	32	39	82.0 "
	" 36 " "	1	6	7	85.7 "
	Over 3 feet from "	1	3	4	75.0 "
IV.	Perforation of:				
	Cæcum or ascending colon	1	4	5	80.0 "
	Transverse colon	0	1	1	100 0 "
	Sigmoid loop	0	1	1	100.0 "
	Meckel's diverticulum	1	2	3	66.6 "
	Appendix	4	4	8	50.0 "

Treatment of Gut.

	Recovered.	Died.	Total.	Mortality.
Intestinal resection with end-to-end anastomosis	1	4	5	80.0 per ct.
Intestines evacuated through the perforation or a puncture	1	1	2	50.0 "
Enterotomy for tympany	1	5	6	83.3 "

Duration of After-treatment in Fatal Cases.

Time.	Cases.	Per ct. of whole number.
Died on table	5	2.1
" under 1 hour	11	4.8
" " 4 hours	20	8.8
" " 8 "	24	10.4
" " 12 "	29	12.6
" " 18 "	15	6.5
" " 24 "	18	7.8
" " 36 "	17	7.4
" " 48 "	21	9.1
" " 72 "	23	10.0
" " 5 days	21	9.1
" " 1 week	7	3.1
Lived over 1 "	11	4.8
" " 2 weeks	3	1.3
" 30 days or more	4	1.8
Total	229	100.0

Analysis as to Drainage.

Cases.[1]	Recovered.	Died.	Total.	Mortality.
Requiring drainage	72	186	258	72.0 per ct.
Not requiring drainage	11	18	29	62.0 "

Number of Operations Performed.

Cases.	Recovered.	Died.	Total.	Mortality.
More than one operation performed	3[2]	5	8	62.5 per ct.

Cases Developing a Fæcal Fistula after Operation.

Time.	Recovered.	Died.	Total.
Within 24 hours	2	1	3
" 36 "	1	0	1
" 48 "	1	0	1
" 72 "	1	0	1
" 5 days	3	1	4
" 1 week	1	0	1
Over 1 "	1	0	1
" 2 weeks	2	0	2
Time unknown	2	0	2
Total cases	14	2	16
Mortality per cent.		12.5	

Treated by :[1]	Recovered.	Died.	Total.	Mortality.
Irrigation and drainage	46	130	176	73.8 per ct.
" but no drainage	7	15	22	68.0 "
No irrigation and no drainage	2	0	2	.. ...
Wiping and drainage	12	19	31	61.0 "
" but no drainage	0	2	2	100.0 "
No wiping and no drainage	2	2	4	50.0 "
Drain, no wiping nor irrigation	10	7	17	41.0 "
Wiping, irrigation, and drainage	1	10	11	90.0 "
Eventration	3	8	11	72.0 "
False anus established	0	4	4	100.0 "

[1] Excluding cases where patient died on the table.

[2] Of the three patients who survived, two endured three operations.

	Recovered.	Died.	Total.	Mortality.
Ambulatory cases	7	16	23	69.5 per ct.
Relapse after operation	6	1	7	14.3 "
Two or more relapses after op.	2	0	2	0.0 "
With other complications	8	11	19	57.8 "
With a subsequent perforation	0	12	12	100.0 "
With a second perforation not found at operation	0	3	3	100.0 "
Perforation not found	5	15	20	75.0 "
Intestinal sutures not holding	13	9	22	40.9 "
Supposed to have recovered from a previous perforation	0	2	2	100.0 "
Subsequent protrusion of bowel through wound	2	0	2	0.0 "

Analysis as to Site of Incision.

Site.	Recovered.	Died.	Total.	Mortality.
Median hypogastric	21	75	96	78.12 per ct.
Right iliac	44	97	141	69.5 "
Left iliac, abscess pointing	2	0	2	
Median epigastric	1	3	4	75.0 "
Right hypochondriac	0	1	1	100.0 "
Multiple incisions	3	11	14	78.5 "
Drainage through loin, flank, or vagina	1	4	5	80.0 "

Analysis of Cause of Death in 89 Cases in Which it is Given.

Causes of death after operation.	Under 12 hrs	Under 24 hrs	Under 3 dys.	Under 1 wk.	Under 2 wks	Over 2 wks	Total	Per ct. of whole No.
Pre-existent peritonitis	17	6	16	4	1	0	44	49.4
Toxæmia of typhoid fever	2	0	5	2	0	0	9	10.1
Peritonitis from subsequent perforat'n	0	0	3	2	3	2	10	11.2
Exhaustion	0	0	0	1	3	1	5	5.6
Intestinal hemorrhage	0	0	1	2	0	0	3	3.4
" obstruction	0	0	3	0	0	0	3	3.4
Other causes, uninfluenced by oper'n.	7	0	8	0	0	0	15	16.8

Analysis of Miscellaneous Laparotomies during Typhoid Fever.

Operations for:	Recovered.	Died.	Total.	Mortality.
Appendicitis	12	4	16	25.0 per ct.
Disease of gall-bladder	4	8	12	66.6 "
Abscess of liver	1	1	2	50.0 "
Diseases of pelvic organs	5	0	5	——
Suppurating mesenteric glands	0	3	3	100.0 "
Intussusception	0	1	1	100.0 "
Chronic intestinal obstruction	1	0	1	——
Peritonitis of unknown cause	2	1	3	33.3 "

List of Cases Analyzed.

N. B. References to Keen, from Nos. 1 to 83 inclusive, refer to the tables in "Surgical Complications and Sequels of Typhoid Fever," Philadelphia, 1898; from Nos. 84 to 158 inclusive, to the tables in "Surgical Treatment of Typhoid Fever," New York State Medical Association Transactions, 1899. References to Finney are to tables in Johns Hopkins Hospital Reports, vol. viii.

Intestinal Perforation.

No.	Operator.	Result.	Reference.
1.	Abbe.	Recov.	New York Med. Record, Jan. 5, 1895. Keen, 25. Finney, 1.
2.	"	Died.	Keen, Trans. New York State Med. Assoc, 1899. Keen, 85.
3.	"	"	Ibid. Keen, 84.
4.	Alexandroff.	"	Journ. de Clin. et Thrapeut. Enfantiles, Paris, 1894, ii. 735. Laetop, Khirurg. Obshtsh. v. Mosk., 1891, x. 121–129, in Annals of Surgery, 1897, i. 267. Keen, 27.
5.	Allen, D. P.	"	American Journ. Med. Sciences, January, 1902, p. 43.
6.	" "	"	Ibid., p. 50.
7.	Allingham.	"	Trans. Clin. Soc. London, vol. xxvii. Brit. Med. Journ., 1894, vol. i. p. 578. Keen, 24. Finney, 3.
8.	Anderson.	Recov.	Brit. Med. Journ., July 23, 1898. Keen, 86.
9.	Andrews.	"	Annals of Surgery, 1902, vol. xxxvi. p. 623.
10.	Armstrong.	Died.	Montreal Medical Journal, Feb., 1897, p. 601. Keen, 52. Finney, 4.
11.	"	"	Brit Med. Journ., 1896, vol. ii. p. 1621. Keen, 53.
12.	"	"	Ibid. Keen, 54.
13.	"	"	Ibid. Keen, 55.
14.	" (Reporter).	"	Ibid. Keen, 56.
15.	" "	"	Ibid. Keen, 57.
16.	" "	"	Ibid. Keen, 58.
17.	"	"	Keen, 79.
18.	Audet.	"	Archives de Méd. et de Pharmacie Milit., 1899, xxxiv., p. 134.
19.	"	"	Ibid.
20.	Auvray.	"	Bull. et Mém. de la Soc. Anat. de Paris, jan., 1901, p. 65.
21.	"	"	Ibid., p. 66.
22.	Balch	"	Trans. Amer. Surg. Assoc., 1900, p. 419, Case 24.
23.	Ballance.	"	Cargill, Brit. Med. Journ., Dec. 15, 1900, p. 1738.
24.	Banzet.	"	F. Junqua, Thèse de Paris, 1901, p. 60.
25.	Bartleet.	"	Medical News, November, 1887.
26.	Beach.	"	Trans. Amer. Surg. Assoc., 1900, p. 410, Case 9. Boston Med. and Surg. Journ., Oct., 1898, p. 390. Keen, 87. (Age given here as 15 years.)
27.	Beckett.	"	South. California Practitioner, 1899, xiv., 111. Keen, 88.
28.	Bell, James,	"	Medical Chronicle, September, 1895, p. 401. Keen, 18.
29.	" "	"	Ibid. Keen, 21.
30.	Berg.	Recov.	New York Medical Record, March 23, 1901, p. 441.
31.	Bigger.	Died.	British Medical Journal, 1899, vol. i. p. 89. Keen, 89.
32.	Blake.	"	Bost. Med. and Surg. Journ., Feb. 5, 1903, p. 149. Case 10.
33.	Bland-Sutton.	"	Trans. Clin. Soc. London, vol. xxvii. Brit. Med. Journ., 1894, vol. i. p. 578. Keen, 23. Finney, 96.
34.	Bocaloglu.	"	Mauger, Thèse de Paris, 1900, p. 101.
35.	Bogart.	"	Annals of Surgery, May, 1896. Keen, 44.
36.	Boinet.	"	Archives Gén. de Méd, October, 1899, p. 426. Mauger Thèse de Paris, 1900, p. 109.
37.	" (Reporter).	"	Archives Gén. de Méd., 1899, p. 542.
38.	" "	"	Ibid., p. 543.

No.	Operator.	Result.	Reference.
39.	Bontecou.	Died.	Journ. Amer. Med. Assoc., Jan. 28, 1888, p. 106. Keen, 5.
40.	"	"	Ibid., March 29, 1890, p. 455. Keen, 11.
41.	Bowlby.	Recov.	Lancet, January 30, 1897, p. 312. Proc. Royal Med. and Chir Soc. of London, vol. ix. Keen, 61.
42.	"	"	Lancet, January 10, 1903.
43.	Briddon.	Died.	Annals of Surgery, February, 1896, p. 198. Keen, 43.
44.	Briggs, C. E.	Recov.	Amer. Jour. Med. Sciences, January, 1902, p. 47.
45.	Brooks.	"	Trans. Amer. Surg. Assoc., 1900, p. 415. Case 17.
46.	Bruce.	"	Canada Lancet, March, 1902, abstracted in Amer. Med., May, 1902, p. 747.
47.	Brown, F. Tilden.	Died.	Annals of Surgery, March, 1903, p. 380.
48.	"	"	Ibid.
49.	"	Recov.	Ibid.
50.	Brun.	Died.	Bull. et Mém. de la Soc. de Chir. de Paris, nov. 25, 1896, p. 731. Keen, 60.
51.	Burrell.	"	Trans. Amer. Surg. Assoc., 1900, p. 417. Case 19.
52.	Blake, Jos. A.	"	Personal communication.
53.	"	Recov.	Ibid.
54.	Cameron.	Died.	Philadelphia Med. Journ., March 3, 1900, p. 526.
55.	Canoli.	"	Bull. de Soc. Lancisiana d. Osp. di Roma (1895), 1896, xv. i., 9–14. Quoted from Keen, 32.
56.	"	"	Ibid. Keen, 33.
57.	Cargill (Reporter).	"	Brit. Med. Journ., December 18, 1900, p. 1738.
58.	" "	"	Ibid.
59.	Celos. "	"	Bull. et Mém. de la Soc. Anat. de Paris, mai, 1900, p. 503.
60.	Champlin.	Recov.	The Plexus, Chicago, 1899, No. 5, vol. v. p. 164. Keen, 155.
61.	"	Died.	Ibid. Keen, 156.
62.	"	"	Ibid. Keen, 157.
63.	Chevalier.	Recov.	Bull. et Mém. de la Soc. de Chir. de Paris, juin 11, 1902, p. 662.
64.	"	"	Ibid., p. 663.
65.	Cholzow.	Died.	Ann. der Russ. Chir., 1896, Heft 2, in Centralbl. f Chir., 1896, No. 42. Keen, 59.
66.	Cushing, H.	Recov.	Johns Hopkins Hosp. Bull., 1898, vol. ix. p.267. Ibid. Reports, vol. viii. p. 210. Keen, 90,
67.	"	Died.	Johns Hopkins Hosp. Reports, vol. viii. p. 218. Keen, 91.
68.	"	"	Ibid. Keen, 92.
69.	"	"	Phila. Med. Journ., March 3, 1900, p. 505. Keen, 93.
70.	"	Recov.	Annals of Surgery, 1901, vol. xxxiii. p. 550.
71.	Dalton.	Died.	Medical Review, St. Louis, 1898, vol. xxxviii. p. 392. Keen, 95.
72.	"	"	Ibid. Keen, 96.
73.	Dalziel.	"	Keen, Trans. New York State Med. Assoc. Keen, 97.
74.	"	"	Ibid. Keen, 98.
75.	"	"	Ibid. Keen, 99.
76.	"	"	Ibid. Keen, 100. Finney 34.
77.	"	"	Ibid. Keen, 101.
78.	"	Recov.	Ibid. Keen, 102.
79.	Dandridge.	"	Keen, 28.
80.	"	Died.	Cincinnati Lancet-Clinic, Aug. 21, 1897, p. 177. Keen, 65.
81.	Da Costa.[1]	"	Allyn, Phila. Med. Journ., Aug. 3, 1901, p. 193. "Modern Surgery," 1903, 4th ed., p. 724.
82.	Davis, G. G.	Recov.	Univ. Med. Mag., May, 1900, p. 172. Episcopal Hospital Records, Philadelphia.

[1] See also Nos. 360, 361, and 362.

No.	Operator.	Result.	Reference.
83.	Davis, G. G.	Died.	Univ. Med. Mag., loc. cit., p. 173. Episcopal Hospital Records.
84.	"	"	Episcopal Hospital Records.
85.	"	"	Ibid.
86.	"	"	Ibid.
87.	"	"	Ibid.
88.	"	"	Ibid.
89.	Davis, R. T.	Recov.	Amer. Med., January 18, 1902, p. 116.
90.	Deanesly & Malet.	"	Lancet, May 25, 1901, p. 1466.
91.	Deaver, H. C.	Died.	Episcopal Hospital Records.
92.	"	"	Amer. Journ. Med. Sci., Feb., 1898, p. 191. Keen, 104.
93.	"	"	Episcopal Hospital Records.
94.	"	"	Ibid.
95.	"	"	Ibid.
96.	Deaver, J. B.	Recov.	Amer. Journ. Med. Sci., Feb., 1898, p. 191. Keen, 103.
97.	"	Died.	Annals of Surgery, 1898, p. 144. Keen, 105.
98.	Delore.	"	Mouriquand, Lyon Méd., juillet 12, 1903, p. 41.
99.	"	"	Ibid., p. 40.
100.	Depage.	Recov.	Journ. de Chir. et Annales de la Soc. Belge de Chir., November-December, 1902.
101.	Eliot.	"	Trans. Amer. Surg. Assoc., 1900, p. 415. Case 16. New York Med. Record, Dec. 22, 1900, p. 968. Keen, 94.
102.	Ferraresi.	"	Bull. de Soc. Lancisiana d. Osp. di Roma (1895), 1896, xv. i., 9–14 (quoted in Keen). Keen, 31.
103.	Ferrier.	Died.	Bull. et Mém. de la Soc. Méd. des Hôpitaux, fev. 8, 1901, p. 112.
104.	"	"	Ibid., p. 108.
105.	Finney.	"	Annals of Surgery, 1897, p. 233. Johns Hopkins Hospital Reports, vol. viii. p. 187. Keen, 66.
106.	"	"	Ibid., loc. cit. Keen, 67.
107.	"	Recov.	Ibid., loc. cit., p. 186. Keen, 68.
108.	"	Died.	Johns Hopkins Hosp. Reports, vol. viii. p. 187. Keen, 106.
109.	"	Recov.	Ibid., p. 188. Keen, 107.
110.	"	Died.	Osler, Phila. Med. Journ., Jan. 19, 1901, p. 116. Johns Hopkins Hospital Reports, vol. x., No. 8, p. 430, Case 17.
111.	"	"	Johns Hopkins Hospital Reports, loc. cit., Case 14, p. 420.
112.	Gerster.	Recov.	Berg, New York Med. Record, March 23, 1901, p. 443.
113.	Gesselewitch and Dombrowski.	Died.	Laitop. Russk. Chir., 1897, vol. ii. p. 407. (Quoted in Keen.) Keen, 69. Finney, 46.
114.	Gesselewitch and Wanach.	"	Ibid. Keen, 70. Finney, 50.
115.	Gesselewitch and Kadjanov.	"	Ibid. Keen, 71. Finney, 49.
116.	Gesselewitch and Wanach.	"	Ibid. Keen, 72. Finney, 48.
117.	Gesselewitch and Wanach.	"	Ibid. Keen, 73. Finney, 47.
118.	Gibbon.	Recov.	Pennsylvania Hospital Records.
119.	"	Died.	Ibid.
120.	"	"	Personal communication. St. Joseph's Hosp. Records, Philadelphia.
121.	"	"	Ibid. Polyclinic Hospital Records, Philadelphia.
122.	"	"	Pennsylvania Hospital Records.
123.	"	"	Ibid.
124.	"	"	Ibid.
125.	Godwin.	Died.	Thornton and Godwin, Lancet, August 17, 1901.

No.	Operator.	Result.	Reference.
126.	Goodal & Richards.	Died.	British Med. Journal, 1898, vol. i. p. 1329. Keen, 136.
127.	Gosset.	"	Bull. et Mém. de la Soc. de Chir. de Paris, dec. 26, 1900, p. 119.
128.	Gray.	"	New York Med. Record, April 22, 1899, p. 567. Case 9. Keen, 108.
129.	Guinon (Reporter).	"	Revue Mensuelle des Malades de l'Enfance, juillet, 1899, p. 290.
130.	Hagopoff.	Recov.	Bull. et Mém. de la Soc. de Chir. de Paris, juin 18, 1902, p. 680.
131.	Haggard.	Died.	Trans. South. Surg. and Gyn. Congr., 1899, p. 148.
132.	Hahn.	"	Frank, Beilage zum Centralbl. f. Chir., 1888, vol. xxiv. p. 51. Keen, 9. Finney, 51.
133.	"	"	Ibid. Keen, 10. Finney, 52.
134.	Hare.	"	Intercolonial Quarterly Journ., Feb., 1895. Keen, 29.
135.	Harrison, V. W.	"	North Carolina Med. Journ., Dec. 5, 1897, p. 368. Keen, 82. Finney, 56.
136.	Harrisson.	"	Brit. Med. Journ., Oct. 20, 1894. Keen, 34.
137.	Harte.	"	Pennsylvania Hospital Records.
138.	"	"	Ibid.
139.	"	"	Ibid.
140.	"	Recov.	Episcopal Hospital Records.
141.	"	Died.	Pennsylvania Hospital Records.
142.	"	"	Ibid.
143.	"	"	Episcopal Hospital Records.
144.	"	"	Pennsylvania Hospital Records.
145.	"	Recov.	Ibid.
146.	"	"	Ibid.
147.	"	Died.	Ibid.
148.	"	"	Ibid.
149.	"	"	Ibid.
150.	"	"	Ibid.
151.	"	"	Ibid.
152.	"	"	Ibid.
153.	"	"	Ibid.
154.	"	Recov.	Ibid.
155.	"	Died.	Ibid.
156.	"	"	Ibid.
157.	Hayes.	Died.	Amer. Med., Sept. 6, 1902, p. 379.
158.	"	Recov.	Ibid.
159.	"	Died.	Ibid.
160.	"	Recov.	Ibid.
161.	"	"	Ibid.
162.	"	Died.	Ibid., p. 380
163.	"	"	Ibid.
164.	Hearn.	"	Ibid., May 2, 1903, p. 700.
165.	Henneid.	"	Med. Rev., St. Louis, 1898, vol. xxxvii. p. 392. Keen, 109.
166.	Heurtreaux and Waquet.	Recov.	Mauger, Thèse de Paris, 1900, p. 112.
167.	Heuston.	"	Brit. Med. Journ., November 16, 1901.
168.	Hill, W.	"	Keen, 40.
169.	Hollis.	Died.	Lancet, 1896, vol. i. p. 1284. Keen, 50.
170.	Hotchkiss.	"	N. Y. Med. Journ., Jan. 11, 1896. Keen, 42. Finney, 59.
171.	Hutchinson, J. P.	Recov.	Pennsylvania Hospital Records.
172.	"	Died.	Children's Hospital Records, Philadelphia.
173.	"	"	Episcopal Hospital Records.
174.	"	"	Ibid.
175.	"	"	Lloyd and Coley, Phila. Med. Journ., Jan., 1903, p. 132 (Methodist Hospital Records, Philadelphia).

No.	Operator.	Result.	Reference.
176.	Hutchinson, J. P.	Recov.	Episcopal Hospital Records.
177.	"	Died.	Pennsylvania Hospital Records.
178.	"	Recov.	Ibid.
179.	Hutchison, J. A.	Died.	Keen, 77. Finney, 60. Mauger, 70.
180.	"	"	Keen, 78.
181.	Ill, C. L.	Recov.	Petry, Phila. Med. Journ., Dec. 13, 1902, p. 936.
182.	Jackson.	Died.	N. Y. Med. Record, Oct. 7, 1899, p. 519. Keen, 110.
183.	Jones.	Recov.	Annals of Surgery, July, 1901.
184.	Kadjan.	"	Gesselewitch, St. Petersb. med. Woch., 1898, n. f. 15, No. 3, s. 21.
185.	Kammerer.	"	Seibert, Archives of Pediatrics, Sept., 1902.
186.	Kholtzoff.	Died.	La Presse Méd., mai 18, 1898, p. 271.
187.	Kimura.	"	Sei-i-Kwai Med. Journ., 1890, vol. ix. p. 55, quoted in Brit. Med. Journ., 1890, vol. ii. p. 777. Keen, 14.
188.	Kingsley.	"	Annals of Surg., Mar., 1897, p. 233. Keen, 30. Finney, 63.
189.	Kirkpatrick.	"	Keen, 80.
190.	Korte.	"	Archiv f. klin. Chir., 1892, vol. xliv. p. 646. Keen, 19. Finney, 65.
191.	Kropowski.	Recov.	Gesselewitch, St. Petersb. med. Woch., 1898, n. f. 15. No. 3, s. 23. Keen, 111.
192.	Laidley.	Died.	Amer. Journ. of Obst., Nov., 1895, p. 791. Keen, 38.
193.	Laplace.	"	Tyson, Trans. Coll. Phys. Phila., 1902, p. 133. Personal communication from Prof. Tyson.
194.	Le Conte.[1]	Recov.	Annals of Surgery, 1901, vol. xxxiii. p. 645.
195.	"	Died.	Pennsylvania Hospital Records.
196.	"	"	Ibid.
197.	"	"	Ibid.
198.	Legueu.	"	Mauger, Thèse de Paris, 1900, p. 107.
199.	"	"	Bull. et Mém. de la Soc. de Chir. de Paris, dec. 26, 1900, p. 1156.
200.	"	Recov.	Ibid., loc. cit., p. 1157. Loison, Revue de Chir., 1901, vol. xxiii. p. 179.
201.	Lejars.	Died.	Bull. et Mém. de la Soc. de Chir. de Paris, nov., 1895. Keen, 49. Finney, 68.
202.	"	"	Ibid., nov. 25, 1896. Keen, 76. Finney, 69.
203.	"	"	Ibid., dec. 26, 1900, p. 1158. Mauger, Thèse de Paris, 1900, p. 97.
204.	Levison.	"	Voorsanger, Amer. Med., Aug. 22, 1903, p. 318.
205.	Loison.	Recov.	Bull. et Mém. de la Soc. de Chir. de Paris, dec. 5, 1900. Bull. et Mém. de la Soc. Méd. des Hôpit. de Paris, fevrier 8, 1901, p. 107. Revue de Chir., 1901, vol. xxiii. p. 181.
206.	Lothrop.	Died.	Munro, Bost. Med. and Surg. Journ., Feb. 5, 1903. Case 11.
207.	Lücke.	"	Deut. Zeits. f. Chir., 1886–1887, Bd. xxv. pp. 1–4. Med. News, Nov., 1887. Trans. Amer. Surg. Assoc., 1888, p. 422.
208.	Lund.	"	Warren, Trans. Amer. Surg. Assoc., 1900, p. 414. Case 14. Keen, 112. Finney, 70.
209.	"	"	Ibid., p. 406, Case 2.
210.	"	"	Ibid., p. 408. Bost. Med. and Surg. Journ., 1900, vol. i. p. 688, Case 5.
211.	Lutz.	Recov.	Med. Review, St. Louis, 1898, vol. xxxvii. 392. Keen, 113.
212.	"	"	Ibid. Keen, 114.
213.	"	Died.	Ibid. Keen, 115.
214.	Margarucci.	"	Bull. di Soc. Lancisiana di Osp. di Roma, 1898, xviii., 319. Quoted by Keen. Keen, 116. Finney, 71.

[1] Another patient operated on at the Pennsylvania Hospital by Dr. Le Conte, is convalescent, six weeks having elapsed since operation.

No.	Operator.	Result.	Reference.
215.	Marsden.	Recov.	Lancet, June 23, 1900.
216.	"	Died.	Ibid.
217.	Martin, Edw.	"	Univ. Med. Mag., June, 1899, p. 502. Keen, 117.
218.	"	Recov.	Ibid. Keen, 118.
219.	McArthur.	Died.	Annals of Surgery, 1902, vol. xxxvi. p. 624.
220.	"	"	Ibid.
221.	"	"	Ibid.
222.	McReynolds.	Recov.	Trans. Coll Phys. Phila., 1902, p. 134. Personal communication.
223.	"	Died.	Proceedings of Phila. Acad. of Surgery, April 6, 1903. Personal communication.
224.	"	"	Ibid.
225.	"	"	Ibid.
226.	Miclescu.	Recov.	Therapeutische Monatshefte, Dec., 1902, p. 631.
227.	Mignon.	Died.	Loison, Revue de Chir., Paris, 1901, vol. xxiii. p. 179.
228.	Mikulicz.	Recov.	Volkmann's Samml. klin. Vorträge, No. 262. Chirurgie, April, 1884, No. 83. Keen, 1. Finney, 72.
229.	"	Died.	Verhandlungen der Deutschen Gesellschaft f. Chir., xviii. Kongress, s. 324. Keen, 7. Finney, 74.
230.	Mitchell, C. F.	"	Pennsylvania Hospital Records.
231.	"	"	Ibid.
232.	"	Recov.	Ibid.
233.	Mitchell, J. F.	"	Johns Hopkins Hosp. Reports, vol. x. p. 409. Case 11.
234.	"	Died.	Ibid., p. 412. Case 12.
235.	"	Recov.	Ibid., p. 416. Case 13. Osler, Phila. Med. Journ., Jan. 19, 1901, p. 116.
236.	"	Died.	Johns Hopkins Hosp. Reports, vol. x. p. 423. Case 15.
237.	"	"	Ibid., p. 426. Case 16.
238.	Mixter.	"	Trans. Amer. Surg. Assoc., 1900, p. 410. Case 8.
239.	Monks.	"	Munro, Boston Med. and Surg. Journ., February 5, 1903, p. 149. Case 15.
240.	Monod.	"	Bull. et Mém. de la Soc. de Chir. de Paris, nov. 18, 1896. Keen, 62.
241.	"	"	Ibid., dec. 12, 1900.
242.	Moore, J. E.	"	Northwestern Lancet, 1898, vol. xviii. p. 135. Keen, 119.
243.	Morestin,	"	Mauger, Thèse de Paris, 1900, p. 104.
244.	Morton, T. G.	"	Medical News, Dec. 24, 1887, p. 730. Keen, 6.
245.	Mower-White.	Recov.	Lancet, January 26, 1901.
246.	Moynihan.	Died.	British Med. Journ., 1899, vol. i. p. 1097. Keen, 120.
247.	Munro.	"	Burrell and Bottomly, Boston City Hospital Reports, 1898, p. 126. Keen, 122. Finney, 78.
248.	"	"	Trans. Amer. Surg. Assoc., 1900, p. 409. Case 7. Bost. Med. and Surg. Journ., Feb. 5, 1903. Case 6. Keen, 121.
249.	"	"	Trans. Amer. Surg. Assoc., 1900, p. 409. Case 6. Bost. Med. and Surg. Journ., 1900, vol. i. p. 688. Case 6. Ibid., Feb. 5, 1903, p. 149. Case 9.
250.	"	"	Trans. Amer. Surg. Assoc., loc. cit. Case 12. Bost. Med. and Surg. Journ., loc. cit., 1903. Case 7.
251.	"	"	Trans. Amer. Surg. Assoc., loc. cit. Case 20. Bost. Med. and Surg. Journ., loc. cit. Case 8.
252.	"	"	Bost. Med. and Surg. Journ., loc. cit., p. 148. Case 1.
253.	"	"	Ibid. Case 2.
254.	"	"	Ibid. Case 3.
255.	"	"	Ibid. Case 4.
256.	"	"	Ibid. Case 5.
257.	Murphy.	"	Keen, 22.
258.	"	Recov.	Keen, 41.

No.	Operator.	Result.	Reference.
259.	Murphy.	Recov.	Journ. Amer. Med. Assoc., April 11, 1903, p. 978.
260.	Mühsam.	"	Deutsche med. Woch., 1901, No. 32, s. 534.
261	Müller.	"	Deutsche Militärärztliche Zeitsch., 1901, vol. xxx. s. 501.
262.	Neilson.	Died.	Episcopal Hospital Records.
263.	"	"	Ibid.
264.	Nevison.	"	Amer. Journ. Med. Sciences, Jan., 1902, p. 39. Case 1.
265.	"	"	Ibid., p. 41. Case 2
266.	Nichols.	"	Bost. Med. and Surg. Journ., Feb. 5, 1903. Case 12.
267.	Nutt.	Recov.	McCormick, Therapeutic Gazette, Aug. 15, 1903, p. 513.
268.	Ortmann.	Died.	Mikulicz, Verhandlungen der Deut. Gesellschaft f. Chir., xviii Kongress, p. 324. Keen, 7. Finney, 74.
269.	Panton.	Recov.	Annals of Surgery, Aug., 1897, p. 219. Keen, 64.
270.	Parkin.	Died.	British Med. Journ., 1895, vol. i. p. 192. Keen, 37.
271.	Patteson.	"	Taylor, Dublin Journ. Med. Sci., Jan., 1901, p. 3.
272.	Pearson.	Recov.	British Med. Journ., vol. i. p. 1097. Keen, 125.
273.	Peyrot.	"	Mauger, Thèse de Paris, 1900, p. 25.
274.	"	"	Ibid., p. 98.
275.	Pick.	Died.	Trans. Clin. Soc. London, 1898, p. 234. Brit. Med. Journ., 1898, vol. i. p. 1328. Keen, 126.
276.	Platt, J. E.	Recov.	Lancet, Feb. 25, 1899, p. 505. British Med. Journ., 1899, vol. i. p. 345. Keen, 127.
277.	"	Died.	Ibid. Keen, 128.
278.	"	"	Ibid. Keen, 129.
279.	"	"	Keen, 130.
280.	"	"	Keen, 131.
281.	Pluyette.	"	Mauger, Thèse de Paris, 1900, p. 105. Archives Générales de Médecine, 1899, N. S., vol. ii. p. 539.
282.	Porter.	"	Boston Med. and Surg. Journ., April 15, 1897, p. 354. Trans. Amer. Surg. Assoc., 1900, p. 411. Case 10. Keen, 63 and 132. Finney, 87.
283.	"	"	Trans. Amer. Surg. Assoc., 1900, p. 413 Case 13.
284.	Post.	"	Munro, Bost. Med. and Surg. Journ., Feb. 5, 1903. Case 14.
285.	Powers.	"	Keen, 134.
286.	Price, Jos.	Recov.	Canada Lancet, April, 1898, p. 386. Med. and Surg. Reporter, 1896, p. 577. Keen, 46. Finney, 88.
287.	"	"	Canada Lancet, 1897, vol. xxx. p. 385. Med. and Surg. Reporter, loc. cit. Keen, 135.
288.	"	"	Canada Lancet, April, 1898. Med. and Surg. Reporter, loc. cit. Keen, 45. Finney, 89.
289.	Rath.	Died.	Records of St. Timothy's Hospital, Roxborough, Phila.
290.	"	"	Ibid.
291.	"	"	Ibid.
292.	Ricard.	Recov.	Bull. et Mém. de la Soc. de Chir. de Paris, juin 18, 1902, p. 680.
293.	Ricketts.	Died.	Cincinnati Lancet-Clinic, April 6, 1895, p. 383. Keen, 36.
294.	Rochard.	"	Bull. et Mém. de la Soc. de Chir. de Paris, dec. 26, 1900, p. 1161.
295.	"	"	Ibid.
296.	Rodman.	Recov.	Amer. Med., Nov. 23, 1901.
297.	Rogers.	Died.	Trans. South. Surg. and Gyn. Congress, 1899, p. 148.
298.	Ross, G. G.	"	Philadelphia Med. Journ., May 2, 1903, p. 748.
299.	Routier.	"	Bull. et Mém. de la Soc. de Chir. de Paris, dec. 26, 1900, p. 1161. Ibid., Nov. 18, 1896, p. 728. Keen, 51.
300.	Ryan.	"	Australasian Medical Gazette, 1899, vol. xviii. p. 334. Keen, 137.
301.	Sacquépée.	"	Bull. et Mém. de la Soc. Anat. de Paris, 1899, vol. lxxiv., p. 443. Mauger, Thèse de Paris, 1900, p. 99.
302.	Saleeby.	Recov.	Phila. Med. Journ., Aug. 5, 1899, p. 270. Keen, 158.

No.	Operator.	Result.	Reference.
303.	Senn.	Died.	Medical News, June 8, 1889, p. 622. Keen, 12. Finney, 93.
304.	"	"	Keen, 139.
305.	"	Recov.	Keen, 140.
306.	"	Died.	Keen, 141.
307.	Shepherd, F. J.	Recov.	Edinburgh Med. Journ., 1902, vol. liv. p. 531.
308.	"	"	Ibid., p. 532.
309.	"	"	Ibid., p. 534.
310.	Shoemaker, G. E.	Died.	Phila. Med. Journ., May 31, 1902, p. 981. Trans. Coll. Phys. Phila., 1902, p. 127.
311.	Sieur.	"	Loison, Revue de Chir., Paris, 1901, vol. xxiii. p. 179.
312.	Sifton.	Recov.	Chicago Clin. Review, April, 1895. Keen, 48. Finney, 94.
313.	Soulligoux.	Died.	Mauger, Thèse de Paris, 1900, p. 102.
314.	"	"	Ibid., p. 103.
315.	Stewart, F. T.	"	Pennsylvania Hospital Records.
316.	"	"	Ibid.
317.	"	"	Ibid.
318.	"	Recov.	Ibid.
319.	"	Died.	Personal communication. Records of Polyclinic Hospital, Philadelphia.
320.	"	"	Ibid. Records of Jefferson College Hospital, Phila.
321.	Spellissy.	Recov.	Proceedings of Phila. Acad. of Surg., April 6, 1903.
322.	Surmay.	Died.	L'Union Méd., 1885, vol. xl. p. 901. Keen, 3.
323.	Taylor, H. M.	"	Virginia Med. Semi-monthly, Dec. 10, 1867, p. 516. Trans. South. Surg. and Gyn. Congr., 1899, p. 140. Case 1. Keen, 83.
324.	"	Recov.	Virginia Med. Semi-monthly, 1898–1899, vol. iii. p. 719. Trans. South. Surg. and Gyn. Congr., loc. cit., p. 142. Case 3. Keen, 142.
325.	"	Died.	Virginia Med. Semi-monthly, loc. cit. Trans. South. Surg. and Gyn. Congr., loc. cit., p. 142. Case 2. Keen, 143. Finney, 98.
326.	"	"	Maryland Med. Journ., 1899, vol, xlii. p. 101. Trans. South. Surg. and Gyn. Congr., loc. cit., p. 143. Case 4. Keen, 144.
327	"	"	Trans. South. Surg. and Gyn. Congr., loc. cit.
328.	Taylor, W.	"	Dublin Journ. Med. Science, Jan., 1901, p. 1.
329.	Taylor, W. J.	"	Trans. Coll. Phys. Phila., 1899, p. 107. Keen, 145.
330.	"	"	Ibid., p. 108. Keen, 146.
331.	Thermet.	"	Monod & Vanverts, Revue de Chir., 1897, vol. xvii. p. 169, where it is quoted from Barbe, Thèse de Paris, Obs. 20.
332.	Thompson.	"	Trans. Amer. Surg. Assoc., 1900, p. 412. Case 11. Keen, 133.
333.	Thompson, J. E.	"	Trans. Texas State Med. Assoc., 1893, p. 266. Med. Chron., 1895, p. 401. Keen, 20. Finney, 101.
334.	"	"	Med. Chron., loc. cit. Keen, 39. Finney, 100.
335.	Thorndike.	"	Trans. Amer. Surg. Assoc., 1900, p. 406. Case 1.
336.	"	"	Ibid., p. 416. Case 18.
337.	"	Recov.	Boston Med. and Surg. Journ., Feb. 5, 1903. Case 13.
338.	Thurston,	"	Lancet, Oct. 14, 1899. Ibid., Feb. 1899, p. 1004. Keen, 148.
339.	Tiffany.	Died.	Keen, 147. Finney, 102.
340.	Trojanoff.	Recov.	Bolnitschnaia Gaseta Botkina, No. 23, 1894, abstracted in Med. News, 1894, vol. lxv. p. 609. Junqua, Thèse de Paris, 1901. Case 61. Keen, 26, 124.
341.	"	Died.	Laitop. russk. Chir., 1897, vol. ii. p. 277, in Mauger, Thèse de Paris, 1900. Case 16. Keen, 74 and 123. Finney, 103.
342.	Valence.	"	Loison, Revue de Chir., Paris, 1901, vol. xxiii. p. 179.
343.	Van Duyn.	"	Keen, 149.
344.	Van Hook.	Recov.	Med. News, Nov. 21, 1891, p. 591. Keen, 15. Finney, 104.
345.	"	Died.	Ibid. Keen, 16. Finney, 105.

No.	Operator.	Result.	Reference.
346.	Van Hook.	Died.	Ibid. Keen, 17. Finney, 106.
347.	Wagner.	Recov.	Beilage z. Centralbl. f. Chir., 1889, No. 29, p. 66. Keen, 13. Finney, 107.
348.	Wanach.	Died.	Gesselewitch, St. Petersburg med. Woch., 1898, iii. n. f. 15, 23.
349.	Watson, F. S.	Recov.	Boston City Hosp. Reports, 1898, p. 127. Bost. Med. and Surg. Journ., 1896, No. 13. Ibid., 1900, vol. i. p. 688. Case 4. Trans. Amer. Surg. Assoc., 1900, p. 407. Case 4. Keen, 47.
350.	"	Died.	Trans. Amer. Surg. Assoc., 1900, p. 414. Case 15.
351.	Warren, J. C.	"	Ibid., p. 407. Case 3.
352.	Weir.	"	Annals of Surgery, Dec., 1897. Keen, 81. Finney, 110.
353.	Willard.	"	Ibid., 1899, vol. xxix. p. 503. Keen, 151.
354.	v. Winiwarter	"	Polis, Annal. de la Soc. Méd. Chir. de Liege, 1897, vol. xxxvi. p. 266. Keen, 152. Finney, 86.
355.	Wladisslew.	Recov.	Gesselewitch, St. Petersburg med. Woch., 1898, vol. iii., n. f. 15, 23. Keen, 153.
356.	Woodward.	Died.	Boston Med. and Surg. Journ., 1898, vol. cxxxix. p. 544. Keen, 154.
357.	Yule.	Recov.	Edinburgh Med. Journ., 1899, vol. xlvii. p. 360.
358.	"	Died.	Ibid., p. 361.
359.	Zeidler.	"	Netschajeff, Bolnitsch. Gas.Botk., 1894, p.569; in Keen,75.
360.	Da Costa.	"	"Modern Surgery," 4th ed., 1903, p. 724.
361.	"	"	Ibid.
362.	"	"	Ibid.

Mackenzie has reported (Lancet, Sept. 26, 1903, p. 867) two recoveries after operation by Battle for typhoid perforation. These are not included in the above tables.

Exploratory Laparotomies.

1.	Armstrong.	Recov.	Lafleur, Montreal Med. Journ., Feb., 1901, p. 89.
2.	Auvray.	Died.	Bull. et Mém. de la Soc. Anat. de Paris, jan., 1901, p. 68.
3.	Berg.	Recov.	New York Med. Record, March 23, 1901, p. 443.
4.	Briggs.	"	Amer. Journ. Med. Sciences, Jan., 1902, p. 45.
5.	Bull.	"	New York Med. Record, June 1, 1901, p. 873.
6.	Cushing, H.	"	Johns Hopkins Hospital Reports, vol. viii. p. 226.
7.	"	Died.	Philadelphia Med. Journ., March 3, 1900, p. 507.
8.	Davis, G. G.	Recov.	Univ. Med. Mag., May, 1900, p. 171.
9.	Finney.	Died.	Philadelphia Med. Journ., March 3, 1900, p. 503.
10.	Garrow.	Recov.	Hamilton, Montreal Med. Journ., Feb., 1901, p. 93.
11.	Harrisson.	"	British Med. Journ., Oct. 20, 1894, p. 865.
12.	Harte.	"	Pennsylvania Hospital Records.
13.	"	"	Ibid.
14.	Le Conte.	Died.	Ibid.
15.	Mitchell, C. F.	Recov.	Ibid.
16.	Mitchell, J. F.	"	Johns Hopkins Hosp. Rep., vol. x., No. 8, p. 453. Case 21.
17.	"	"	Ibid., p. 447. Case 19.
18.	"	Died.	Ibid., p. 450. Case 20.
19.	Mixter.	Recov.	Trans. Amer. Surg. Assoc., 1900, p. 419. Case 23.
20.	McArthur.	Died.	Annals of Surgery, 1902, vol. xxxvi. (mentioned at p. 622 by Dr. Frank Billings).
21.	Munro.	"	Boston Med. and Surg. Journ., Feb. 5, 1903. Case 18.
22.	"	"	Ibid. Case 19.
23.	Nimier.	"	Loison, Revue de Chir., Paris, 1901, vol. xxiii. pp. 177 and 188.
24.	Rochard.	Recov.	Bull. et Mém. de la Soc. de Chir. de Paris, dec. 26, 1900, p. 1161.
25.	"	"	Ibid.
26.	Rodman.	Died.	Proceedings of Phila. Acad. of Surgery, April 6, 1903.

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